UPiS

Uninterruptible Power intelligent Supply

for use with

RaspberryPi®

User Manual

Version 1.01

preliminary

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Firmware Release 1.00

Hardware Release VCO2

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Intelligent Modules for your RaspberryPi®

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Firmware Updates Road Map

The **UPiS** is a hardware platform that covers many features. Most of them are supported by the Firmware Version Release 1.00. However some of them are planned features, and are still under testing or under development phase and will be released soon in the next versions of firmware. The following table describes the Implementation and Versions Release Road Map.

Firmware Version	Features Added
1.00	UPiS Official Firmware Version Release
1.10	1. USB – RS232 interface bridge option (powering matters)
1.20	1. Original micro USB RaspberryPi® powering (the RPI mode) full implementation 2. Onboard ESD Protected I/O pin, controlled via RS232 3. Low Powering Mode when cabling supply is available
1.30	1. Extended Tiny Encryption Algorithm (*XTEA*) cryptographic Customer Software Protection System (with custom defined protection keys) 2. RTC based Alarms for RaspberryPi® wake-up and sleep
1.40	3. Event Driven Advanced Scripting Language

System Overview

Introduction

The **UPiS** is an Advanced Powering add-on Module for the RaspberryPi® that adds to the powering functionality a wealth of additional features. It is equipped with a LiPo battery (1150 or 2600 mAh) and features a buck/boost switching power converter. There is no need for any additional cabling or Power Supply, as the **UPiS** is powered by the same Power Supply of your original RaspberryPi®; you just insert the **UPiS** on the top of the **P1** connector of your RaspberryPi®. The **UPiS** has an embedded measurement system that continuously checks the powering voltage and current consumption, and when the cable power is absent or insufficient, it automatically switches to the battery source. Then it keeps checking the input voltage on all power sources, and when cable power gets available again, it switches to it automatically, turning the battery source off. The **UPiS** uses exactly the same micro USB Power Supply that you are using to supply your RaspberryPi®, however it has also an Extended External Voltage input[1] for other non-standard powering sources.

Applications

The **UPiS** as an add-on Module is addressed to all users that need a power back-up and/or sensing features for applications running on the RaspberryPi®. All applications running on the RaspberryPi® can take advantage of the *uninterruptible power supply* feature of the **UPiS** (ranging from RaspberryPi®-based fan less servers to solar-powered applications), but in addition the **UPiS** provides a wealth of sensors and features, all cumulated in a single all-in-one unit, that can enable writing many innovative applications.

Features

The features of the **UPiS Module** can be categorized as follows:

- Powering functionalities,
- I/O and control functionalities,
- RTC functionalities,
- Interfaces functionalities,
- Software Protection functionalities,
- Environment supervising functionalities.

In detail the list of **UPiS** features is here below:

4. Supervised and Protected Powering from all cable sources
    - RaspberryPi ® micro USB (5 VDC) – available from firmware release V1.20

[1] the Extended External Voltage input is available only in the Advanced version of the **UPiS**

- Additional micro USB (5V DC)
- Extended External Powering Input (7V DC – 18V DC) [Advanced version only]

5. Battery Power Backup on each cable powering source (including original RaspberryPi® micro USB – optional after firmware activation) – the UPS feature
6. Onboard Rechargeable LiPO Battery (1150/2600 mAh) – battery working time is about 2 or 5 hours, but depending from the version, system load and configuration
7. Onboard enhanced multiple level protection system for the LiPO battery:
    - Cut-off jumper
    - PTC fuse
    - Onboard Thermometer
    - Over-charge and Over-discharge protection
    - Over-voltage and Under-voltage protection
8. Onboard Intelligent Automatic LiPO Battery Charger (Charges the battery automatically but only if the supply voltage is present and can provide enough current to feed the RaspberryPi® and to charge the battery)
9. RaspberryPi® Hardware ON/OFF Switch
10. Embedded Emulated RTC (Real Time Clock – DS1307) accessible via RaspberryPi® I2C and/or RS232 provided from the System
11. Onboard Analog Thermometer (accessible via RaspberryPi® RS232)
12. Onboard True USB interface (can be used as RS232 – USB Bridge)
13. Programmable Time, RaspberryPi® File Safe Shutdown Button[2]
14. Full monitoring of all UPiS Powering Parameters via RaspberryPi® RS232 port:
    - Current Consumption
    - Voltage on each Power source
    - System Temperature
    - Battery Level
    - Powering source
15. RTC based programmed Startup/Shutdown
16. Onboard UPiS Reset Button (resets UPiS and RaspberryPi® but not RTC by cutting the powering of the RaspberryPi® for a very short time)
17. Onboard NO RELAY controlled via RS232 or RaspberryPi® Pin (selectable by jumper GPIO_GEN0)
18. Onboard ESD Protected 1-wire interface, controlled via RS232 or RaspberryPi® Pin (selectable by jumper GPIO_GEN3) with separate 3.3V supply pull-up resistor.
19. Onboard ESD Protected I/O pin, controlled via RS232 or RaspberryPi® Pin (selectable by jumper GPIO_GEN3)
20. Onboard True 12 V RS232 interface to the external world (with level converter)
21. Protected (Resettable fuse 140 mA) 5 VDC output for user applications, with battery backup feature
22. Non-protected 3.3 VDC output for user applications (usually used for 1-wire application), separate and independent from the RaspberryPi® 3.3 supply.

[2] requires that the RaspberryPi® be powered from the second micro USB placed on the UPiS board or from Extended External Powering Input

23. Extended Tiny Encryption Algorithm (*XTEA*) cryptographic Customer Software Protection System (with custom defined protection keys)
24. Scripting language
25. LED-based Status Information System
26. Bootloader feature for lifetime firmware update.

System Basics

UPiS Versions

The **UPiS** module is 100% Plug and Play: there is no need to setup anything. There is no need to change the original RaspberryPi® micro USB Power Supply as the **UPiS** module uses exactly the same cabling. You only need to plug-in the **P1** on the RaspberryPi® and switch ON the **UPiS** module in order to supply your system. To take advantage of all the features of the **UPiS**, you will typically connect the original RaspberryPi® micro USB Power Supply to the **UPiS** (thus interposing the UPiS between the power supply and the RaspberryPi®), but if you need to keep the old cabling as it was you can even select to keep the power supply directly connected to the RaspberryPi®.

There are two versions of **UPiS** available: **UPiS Basic** and **UPiS Advanced**. Each one could be ordered in two variants, i.e. with top end or stack **P1** connector. The stack version allows plugging on additional user boards, while the top end should be the end of the RaspberryPi® System.

Cable Powering Sources – the Powering Feature

The **UPiS** module is designed to offer automatic power battery back-up to the RaspberryPi® supplied from the following Cable Powering Sources:

- RaspberryPi ® micro USB (5V DC) – available from firmware release V1.20
- Additional micro USB (5V DC)
- Extended External Powering Input (7V DC – 18V DC) [Advanced version only]

It is recommended to use only one Cable Powering Source at a time, however if more than one of the Cable Powering Sources are available (plug-in) then the **UPiS** runs an automatic process which selects and activates only one. The powering source selection is done according to implemented priority algorithm. The highest priority has the RaspberryPi® original micro USB supply, so if you fit the Cable Power Supply to the RaspberryPi® all other sources will be automatic deselected (internally disconnected) even if you have plug in cables to them. The next priority is the Extended External Powering Input and same as before if you have connected this powering source the **UPiS** micro USB will be not active as a power source, it will be only active as a data connection. And finally the smallest priority has the **UPiS** micro USB powering. Only if all of these cable powering sources are missing the battery back-up is activated and supplying the RaspberryPi®. In practice, because we usual using only one cable power supply (recommended), we are just using the selected cable power source, and when power is down, then immediately battery back-up is starting up.

Summary of power source priorities:

RaspberryPi® micro USB ⇨ Extended External Powering ⇨ UPiS micro USB ⇨ Battery Back-up

Battery Power Backup – the UPS feature

The **UPiS** is an off-line **UPS** with extremely fast switching time and intermediate power preservation (in fact it is line-interactive **UPS**). Decision when battery back-up should be activated is made according of the powering status of the 5V Pin on the **P1** connector and current consumption.

The system continuously monitors the RaspberryPi® **P1** 5V Pin, detects the falling edge of power or lower voltage than the defined threshold and within 360 us it automatically activates the battery back-up powering, thus preventing the Raspberry Pi® from suffering an unexpected power shutdown.

The activation time of battery back-up power is extremely fast and is executed within 120 us and switching of power backup takes less than 14 us. In addition a large tantalum capacitor is supplying the RaspberryPi® system during this off-line time, in order to avoid power glitches.

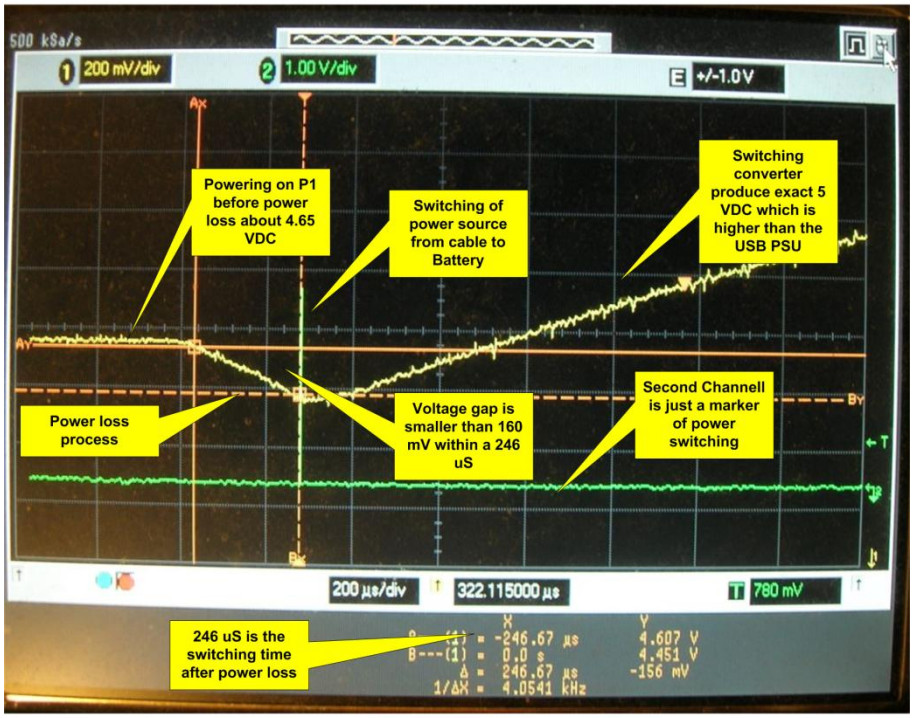

500 kSa/s
1 200 mV/div
2 1.00 V/div
E +/-1.0 V
Powering on P1 before power loss about 4.65 VDC
Switching of power source from cable to Battery
Switching converter produce exact 5 VDC which is higher than the USB PSU
Power loss process
Voltage gap is smaller than 160 mV within a 246 uS
Second Channell is just a marker of power switching
246 uS is the switching time after power loss
200 µs/div
322.115000 µs
780 mV
-246.67 µs
0.0 s
246.67 µs
4.0541 kHz
4.607 V
4.451 V
-156 mV

Figure 1 Battery Powering switching process after a Cable Power loss

UPiS Add-Ons – the Intelligent Features

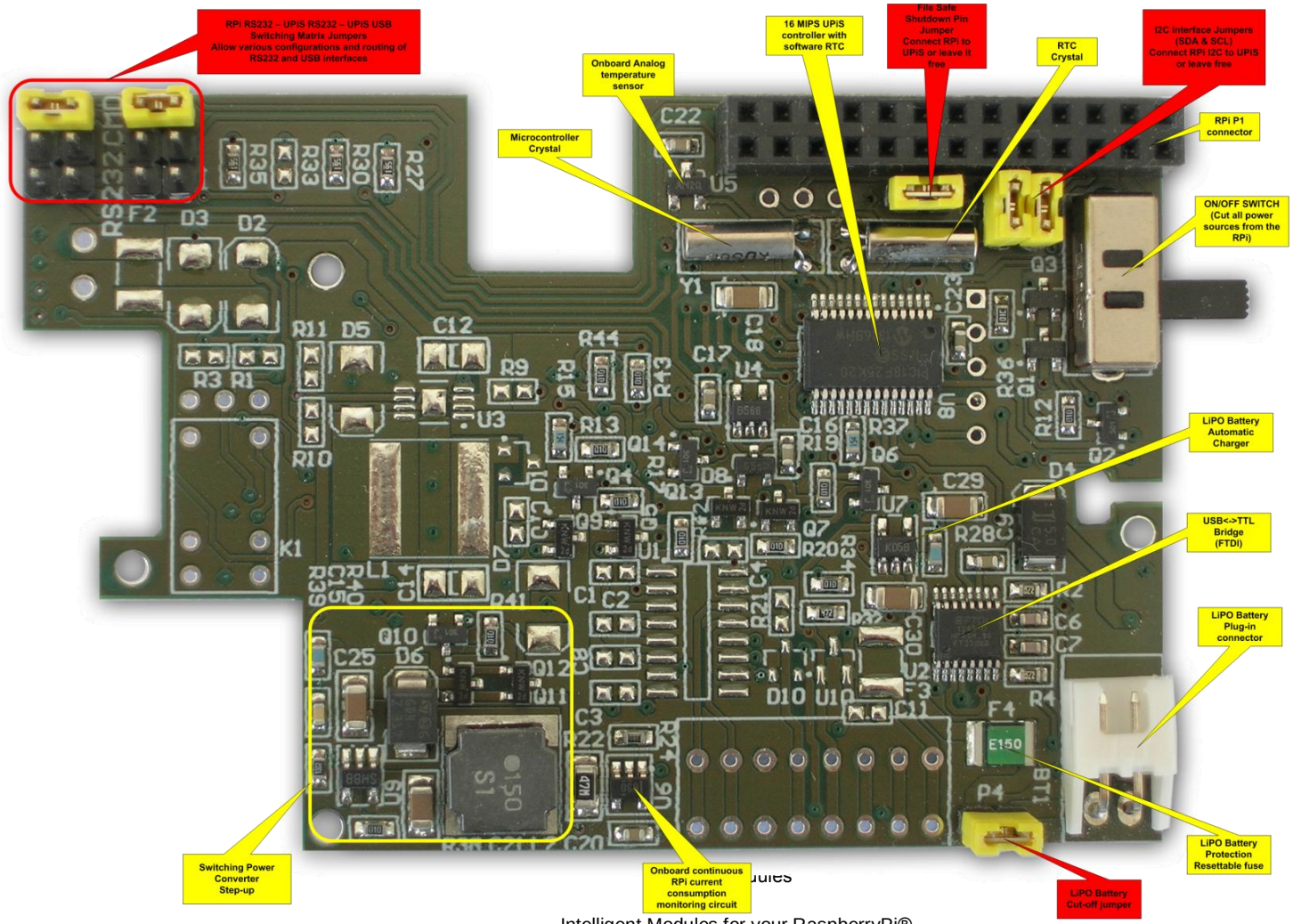
The **UPiS** module first of all, is an **Advanced Powering System** with battery back-up for the RaspberryPi®. It is practically covering most of the possible requirements that user of the RaspberryPi® can have with their system powering. But there's much more than this! Following the main goal of our company "Intelligent Modules for your RaspberryPi®", we tried to design an as most as possible compact device, yet offering as many as possible features for the standard user of the RaspberryPi®. We tried to design an All-in-One device with Plug & Play capability. In fact, you do not need to set anything in order to use the **UPiS** module, just Plug it on the **P1** connector and Play with it! However, if you need more features, you can easily access them by jumpers, adjusting the **UPiS** exactly to your current project requirements.

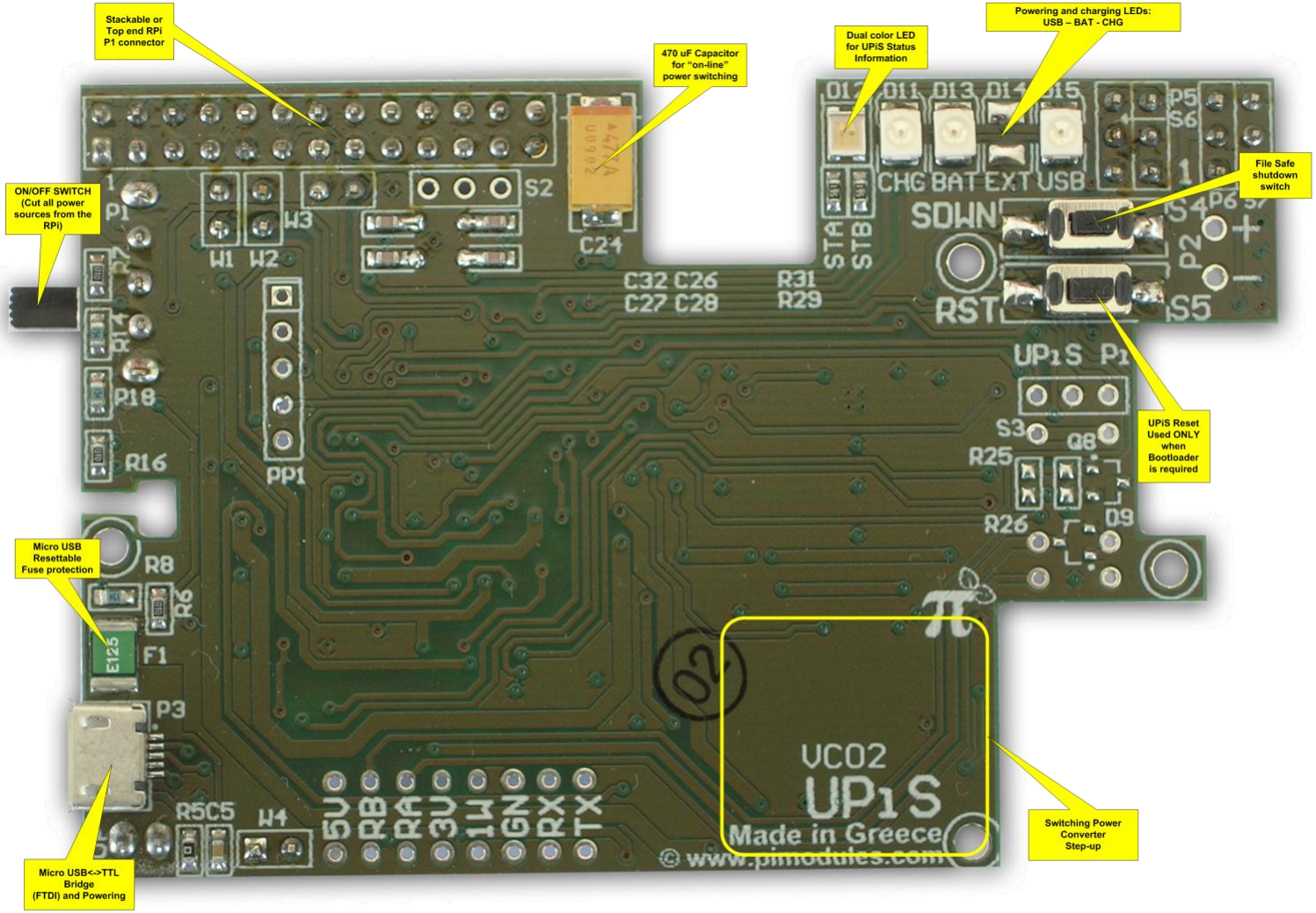
The **UPiS** supports the user with a high number of features in a single low cost module. All of these features will be explained in detail in the following sections.

All of these features will be explained in detail in the following sections.

System components

UPiS (Basic Version) PCB View


RPi RS232 – UPiS RS232 – UPiS USB Switching Matrix Jumpers Allow various configurations and routing of RS232 and USB interfaces
Onboard Analog temperature sensor
16 MIPS UPiS controller with software RTC
File Safe Shutdown Pin Jumper Connect RPi to UPiS or leave it free
RTC Crystal
I2C Interface Jumpers (SDA & SCL) Connect RPi I2C to UPiS or leave free
RPi P1 connector
Microcontroller Crystal
ON/OFF SWITCH (Cut all power sources from the RPi)
LiPO Battery Automatic Charger
USB<->TTL Bridge (FTDI)
LiPO Battery Plug-in connector
LiPO Battery Protection Resettable fuse
LiPO Battery Cut-off jumper
Onboard continuous RPi current consumption monitoring circuit
Switching Power Converter Step-up


Stackable or Top end RPi P1 connector
470 uF Capacitor for "on-line" power switching
Dual color LED for UPiS Status Information
Powering and charging LEDs: USB – BAT - CHG
File Safe shutdown switch
ON/OFF SWITCH (Cut all power sources from the RPi)
UPiS Reset Used ONLY when Bootloader is required
Micro USB Resettable Fuse protection
Micro USB<->TTL Bridge (FTDI) and Powering
Switching Power Converter Step-up
CHG BAT EXT USB
SDWN
RST
VCO2
UP1S
Made in Greece
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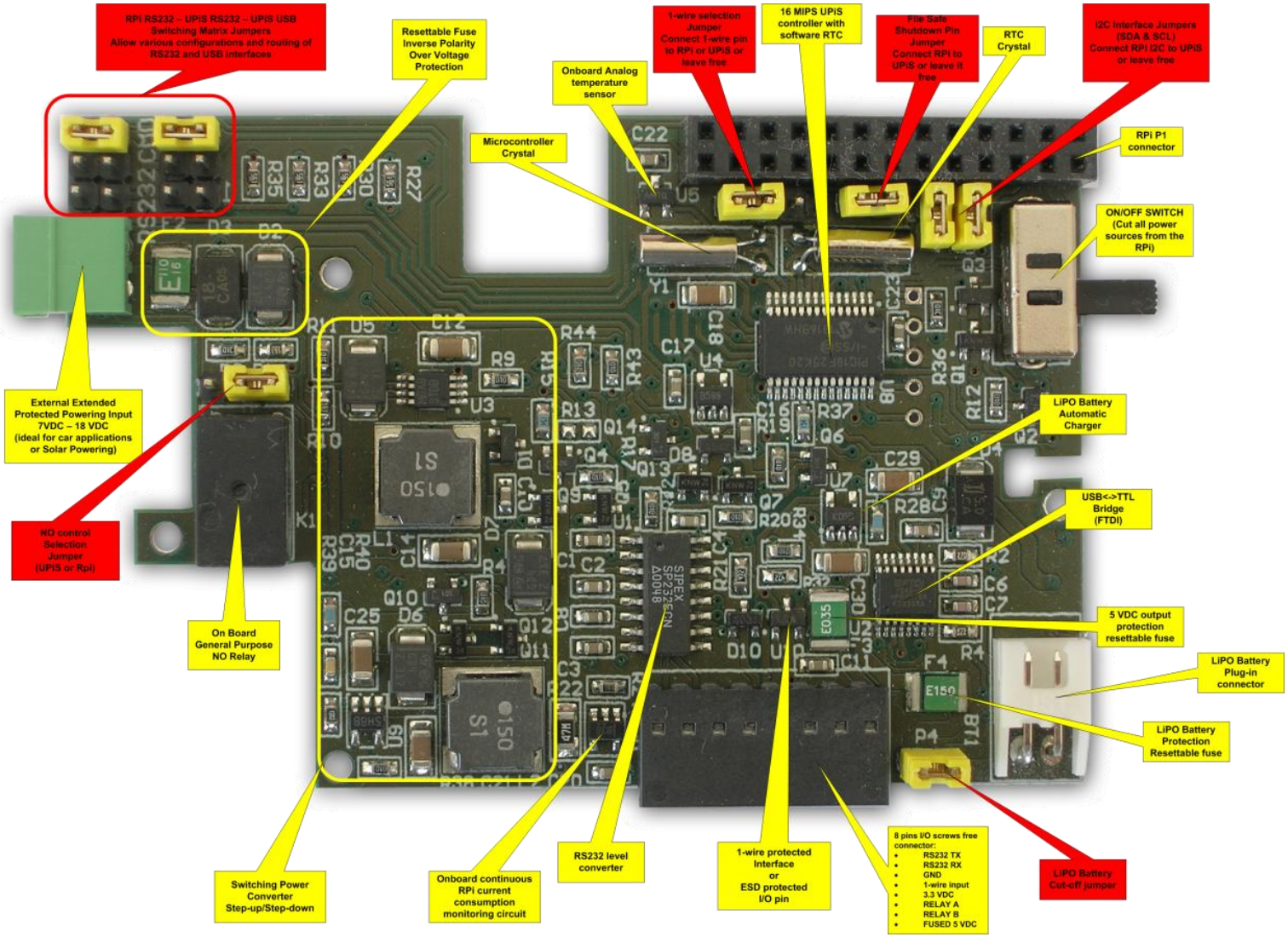
UPiS (Advanced Version) PCB View


RPi RS232 – UPiS RS232 – UPiS USB Switching Matrix Jumpers Allow various configurations and routing of RS232 and USB interfaces
Resettable Fuse Inverse Polarity Over Voltage Protection
Onboard Analog temperature sensor
1-wire selection Jumper Connect 1-wire pin to RPi or UPiS or leave free
16 MIPS UPiS controller with software RTC
File Safe Shutdown Pin Jumper Connect RPi to UPiS or leave it free
RTC Crystal
I2C Interface Jumpers (SDA & SCL) Connect RPi I2C to UPiS or leave free
Microcontroller Crystal
RPi P1 connector
ON/OFF SWITCH (Cut all power sources from the RPi)
External Extended Protected Powering Input 7VDC – 18 VDC (ideal for car applications or Solar Powering)
LiPO Battery Automatic Charger
USB<->TTL Bridge (FTDI)
NO control Selection Jumper (UPiS or RPi)
On Board General Purpose NO Relay
5 VDC output protection resettable fuse
LiPO Battery Plug-in connector
LiPO Battery Protection Resettable fuse
Switching Power Converter Step-up/Step-down
Onboard continuous RPi current consumption monitoring circuit
RS232 level converter
1-wire protected Interface or ESD protected I/O pin
8 pins I/O screws free connector:
RS232 TX
RS232 RX
GND
1-wire input
3.3 VDC
RELAY A
RELAY B
FUSED 5 VDC
LiPO Battery Cut-off jumper

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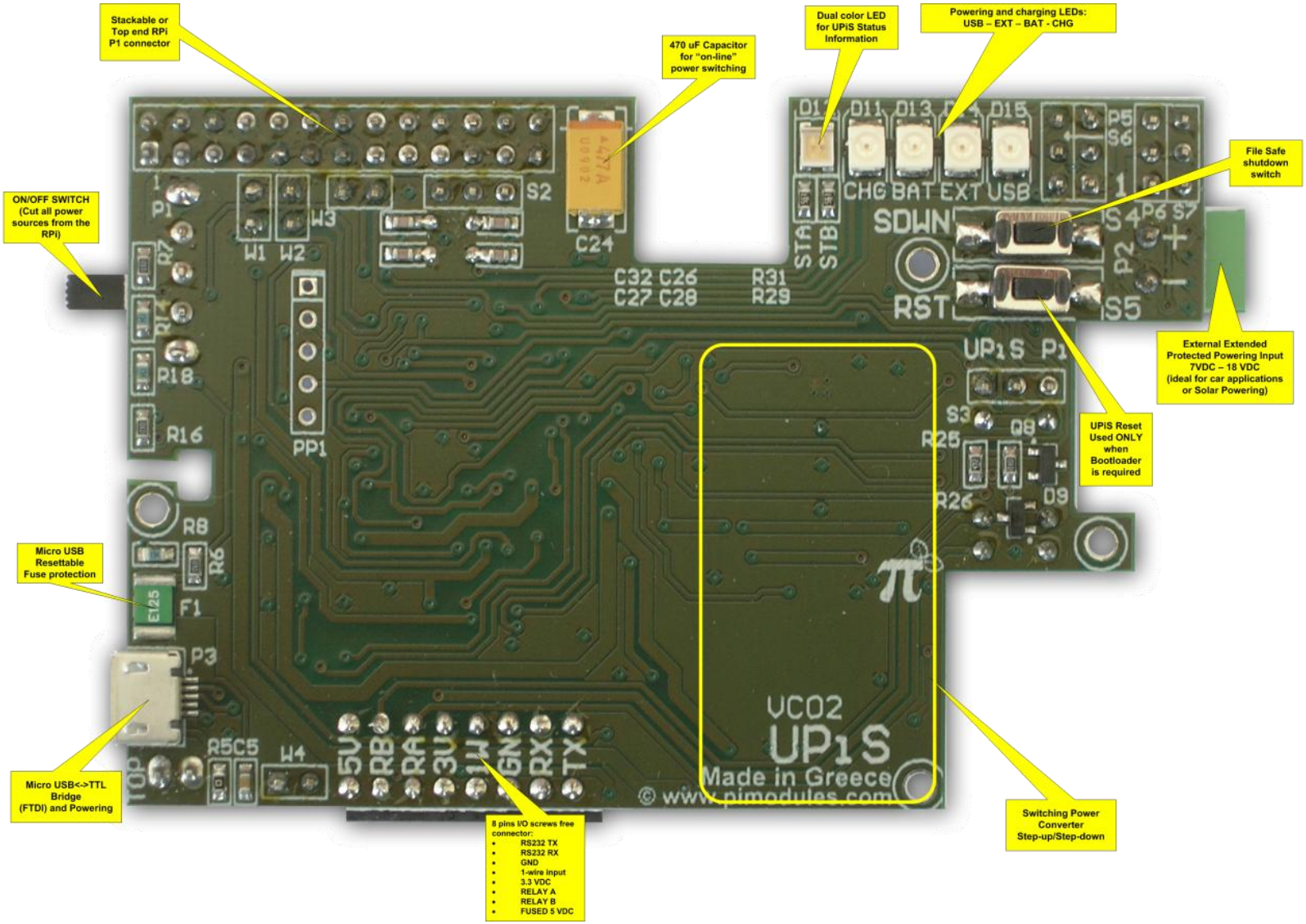
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Micro USB Resettable Fuse protection
Micro USB<->TTL Bridge (FTDI) and Powering
Switching Power Converter Step-up/Step-down
8 pins I/O screws free connector:
RS232 TX
RS232 RX
GND
1-wire input
3.3 VDC
RELAY A
RELAY B
FUSED 5 VDC
CHG BAT EXT USB
SDWN
RST
VC02
UPiS
Made in Greece

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RaspberryPi® micro USB (5 VDC) socket

Valid for the UPiS BASIC and UPiS ADVANCED

The external power supply can be connected directly to this input of the RaspberryPi® board, and the **UPiS** will still provide battery back-up to the RaspberryPi®. If the external power supply is connected directly to the RaspberryPi®, then the **UPiS** will use the **P1** connector both to monitor the powering status and to inject power into the RaspberryPi® when the sensed powering becomes insufficient. However, in this arrangement some functionality of the **UPiS** is not available for it. In particular:

- The hardware switch has no effect
- All timed ON/OFF functionalities are not available
- The measurement of current consumption cannot be performed, so the functionalities that depend on it are not available in this powering option
- Low Powering Mode for the RaspberryPi® is not available.

Therefore, to take full advantage of the **UPiS** functionalities, it is recommended to use this powering input mode only if necessary.

Additional UPiS micro USB (5VDC) socket

Valid for the UPiS BASIC and UPiS ADVANCED

This Cable Powering Source is identical to the original RaspberryPi® micro USB and is protected in the same way (with SMB 5V and 1.25 PTC resettable fuse). If the external power supply of the RaspberryPi® is connected to this input of the **UPiS**, then the **UPiS** will feed the RaspberryPi® through the **P1** connector.

All the features of the UPiS can be exploited when using this connection scheme, therefore it is strongly recommended to use this connection scheme.

Extended External Powering Input (7 VDC – 18 VDC)

Valid for the UPiS ADVANCED only

This Cable Powering Source is designed to support outside word of RaspberryPi® application. Trough this Cable Powering Source it can be supplied with power from 7 V DC up to 18 VDC. It equipped with enhanced protection system which contains: reverse polarity protection, overvoltage protection as also PTC resettable fuse of 1.25 A. A dedicated switching converter converts the incoming power to 5 V DC, The maximum current of the 1.4 A, however to safety reasons, the current monitoring system allows to draw continuously only 850 mA from it. It is ideal for car application, solar applications and basically whenever stable power supply is not available.

Onboard Rechargeable LiPO Battery (1150 mAh or 2600 mAh)

Valid for the UPiS BASIC and UPiS ADVANCED

The **UPiS** is equipped with a LiPO battery. It is the power source when cable powering is missing. There are two type of batteries offered depending of version of the **UPiS**. The **UPiS** Basic LiPO Battery capacity is 1150 mAh, and for the **UPiS** Advanced LiPO Battery capacity is 2600 mAh. The LiPO batteries have been selected as a backup power sources due to best relation between size, weight, price, and power capacity. However a special care is needed to avoid unexpected events like overheating, fire or even explosion. Therefore you are kindly requested to avoid any mechanical damage of such types of batteries like drilling, cutting or breaking. If you recognize such type of battery damage please immediately disconnect it from the system and put on safety place, before recycle it.

LiPO Battery Protection System

Valid for the UPiS BASIC and UPiS ADVANCED

The UPiS is equipped with series of battery protections in order to avoid any dangerous incidents. There are:

- **Analog thermometer**

  The embedded UPiS microcontroller, based on the integrated analog thermometer, continuously checks the UPiS-PCB-System-Environment-Battery temperature and whenever exceeds the 60 Celsius Degrees stop the charging process, and if exceeds 60 Celsius Degrees initiate the UPiS emergency shutdown procedure and File Safe RaspberryPi® System shutdown. As the result it cut the system powering for security reasons.

- **PTC resettable fuse**

  Battery is connected to the system through a 2.6 A PTC resettable fuse. Whenever battery current exceeds this value (during charging or powering process) battery will be automatic cut-off from the system and will remain in this stage until powering requirements come back to the normal conditions.

- **Cut-off power jumper**

  Battery powering of the system is going thought a cut-off jumper. In order to have battery connected to the system it is necessary to short it with jumper. **It is strongly recommended for security reasons, to keep this jumper open (battery disconnected) when system is transported and not human supervised i.e. via Airplane.** It is important to know that emulated RTC (running on the microcontroller) is powered by the same battery with the rest of the system. Therefore disconnecting of the system battery will cause immediate lost of its settings.

- **Continuously current monitoring**

The **UPiS** is equipped with embedded real-time current monitoring. Value of current consumption is continuously monitored by the microcontroller and whenever exceeds predefined values; initiate the File Safe RPi System shutdown procedure. As the result it cut the system powering for security reasons.

In addition each LiPO battery is equipped itself with protection PCB which controls the over-charge and over-discharge conditions of the battery. This circuit automatically cut-off battery from power source when battery level is lower than 3 V during discharge and higher than 4.2 V during charge process. This security system is implemented in order to save battery live in addition to already existing protections embedded in the battery charger.

Intelligent Automatic LiPO Battery Charger

Valid for the UPiS BASIC and UPiS ADVANCED

UPiS has implemented an automatic charger that control the battery level and when it is necessary charge it. When battery is full it automatically switches to trickle charging in order to keep battery in a good conditions all the time. Trickle charging means charging a fully charged battery under no-load at a rate equal to its self-discharge rate, thus enabling the battery to remain at its fully charged level. It is an automatic process and user does not need to intervene on it. The charger is intelligent and full microcontroller supervised. It is dynamically switching ON and OFF the charging process whenever powering supply is not able to provide enough current for the RaspberryPi® and battery charging. The integrated battery is charged with a stable current of 212 mA.

Powering Modes

Valid for the UPiS BASIC and UPiS ADVANCED

The RaspberryPi® has various powering requirements depending to connected power source and System Status. In example powering requirements and functionalities are different when System is running on Battery or on USB cable powering (i.e. when system is running on Battery (the UPS feature there is no battery charging). Therefore, in order to support it, the **UPiS** follows System Power Requirements switches automatically to various powering modes. There are 5 different powering states in the internal **UPiS** State Machine:

- USB - **USB** Cable Powering
- EPR - **E**xternal Cable **P**owe**R**ing
- BAT - **Bat**tery Powering
- LPR - Battery **L**ow **P**ower**r**ing
- RPI - **RPi** Powering

Switching between modes is done automatically by internal **UPiS** state machine and depends to various system parameters like Voltage on the **P1** connector (5 V), Voltage on the cable powering inputs (like EPR, USB), current consumption etc. Changes between various

powering states can be monitored using scripting language, giving to the user exact information about what powering mode is currently running. However the switching procedure between each mode is completely automatic and user do not need to do anything in order to follow it. The powering modes information is addressed to more advanced users who need to use this information for their dedicated application. A short description of each powering mode as also required conditions when it switching on is described below.

USB Mode - USB Cable Powering

The **USB Mode** is the basic running mode of the **UPiS** and is used in most applications. It happens when USB powering cable is connected to the **UPiS** micro USB connector and RaspberryPi® is running drawing power from the **UPiS** through **P1** connector. The mechanical switch is switched ON. Absence of **UPiS** micro USB cable power switches automatically the **UPiS** to the **BAT** mode when the RaspberryPi® system is running on power drawing from the internal battery. All functionalities of the System are available and running.

EPR Mode - External Cable PoweRing

The **EPR Mode** is the second of cable powering mode of the UPiS and used in the most embedded applications. This mode happens when Extended External Powering is connected to the power (7V DC – 18V DC) and RaspberryPi® is running drawing power from the **UPiS** through **P1** connector. The EPR mode has absolute priority in UPiS System Powering. That means if you have connected 2 cables the Extended External Powering Cable and the UPiS micro USB Cable, the system will automatically select powering from the EPR, and internally disconnect the micro USB cable from powering. Therefore the micro USB Cable will be still connected, but will act only as a data connection if it is connected to PC. The mechanical switch is switched ON. Absence of **UPiS** micro EPR cable power (and not availability of USB cable) switches automatically the **UPiS** to the **BAT** mode when the RaspberryPi® system is running on power drawing from the internal battery. All functionalities of the System are available and running.

BAT Mode – BATtery Powering

The **BAT Mode** is UPS mode and happens when Cable Power is not available (the EPR, USB and RPI). In that case the internal switching regulator, produce the necessary power from integrated battery, and supply the RaspberryPi® with power from the **UPiS** through **P1** connector. Switching time is extremely short (less that 14 uS within 120 uS window) and the RaspberryPi® does not “know” that it is still powered form battery. If Cable Power returns then the system switches back to it within 3.6 seconds. This delay in switching back to the cable power is necessary in order to stabilize the power source. Any instability of the cable power within this 3.6 second time cause resetting of the internal timer and counts the 3.6 seconds again until cable power will be stable for this required time. During using the RaspberryPi® the current flow is many time high for a short times, therefore it is possible that user will see switch to the BAT mode even if cable is still connected. It happens because

the availability of power in the PSU is not so fast as expected, which cause falling ages of voltage, and it activates the BAT Mode in order save powering conditions of 5V on p1 connector. All functionalities (except of battery charging) of the System are available and running.

LPR Mode – Low Powering Mode

The **LPR Mode** is variation of the BAT Mode and happens when the RaspberryPi® is not drawing a power for the UPiS. Therefore the UPiS in order to save energy switch off most of the peripherals, microcontroller and goes to sleep mode. During this more it consumes only 60 uA, and the only continuously running peripheral is the RTC. Periodically check the Cable Powering Conditions and if it comes back switch the back to the appropriate Cable Mode. Exceed for this mode is also possible by pressing the **SHDN** button, it will start up the RaspberryPi® and switch to the BAT Mode back.

RPI Mode – RaspberryPi® Cable Powering

This is the final and used very sporadic RPI Mode. It happen only when the RaspberryPi® is supplied from their original micro USB socked. Due to still testing of this powering mode (especially the battery powering exit to RPI mode), it is not recommended to use it until next version of firmware, where will be included in their full version.

Powering Mode	Description	Functionalities		LED Indications	
EPR	External Cable Powering	**EPR Input:**	Connected	**USB**:	Not Light/Light only if cable connected for data
		USB Input:	Disconnected (or only data)	**EXT**:	Light
		RPi USB Input:	Disconnected	**BAT**:	Light
		RPi Powering:	Powered	**CHG**:	Not Light/Light only when battery is charging
		RPi Switch:	ON	**STA**:	Blinking for 100 mS every 500 mS when cable power is connected
		Battery:	Auto/Intelligent Charging if needed		
		5VDC Output:	ON	**STB**:	Not Light (Light for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure)
		Analog Temp:	ON		
		1-wire:	ON if connected		
		12 V RS-232:	ON		
		USB interface:	ON (Jumpers depending)		
		Relay:	ON/OFF		
		RTC:	ON		
		System Monitoring:	ON		
		Script Machine:	ON		
USB	USB Cable Powering	**EPR Input:**	Disconnected	**USB**:	Light
		USB Input:	Connected	**EXT**:	Not Light
		RPi USB Input:	Disconnected	**BAT**:	Light
		RPi Powering:	Powered	**CHG**:	Not Light/Light only when battery is charging
		RPi Switch:	ON	**STA**:	Blinking for 100 mS every 500 mS when cable power is connected
		Battery:	Auto/Intelligent Charging if needed		
		5VDC Output:	ON	**STB**:	Not Light (Light for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure)
		Analog Temp:	ON		
		1-wire:	ON if connected		
		12 V RS-232:	ON		
		USB interface:	ON		
		Relay:	ON/OFF		
		RTC:	ON		
		System Monitoring:	ON		
		Script Machine:	ON		
BAT	Battery Powering	**EPR Input:**	Disconnected	**USB**:	Not Light
		USB Input:	Disconnected	**EXT**:	Not Light

		RPi USB Input:	Disconnected	**BAT**:	Light
		RPi Powering:	Powered	**CHG**:	Not Light
		RPi Switch:	ON	**STA**:	Blinking for 100 mS every 500 mS when cable power is connected
		Battery:	Not charged		
		5VDC Output:	ON	**STB**:	Not Light (Light for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure)
		Analog Temp:	ON		
		1-wire:	ON if connected		Light for 100 mS every 1000 mS when UPiS is running on battery backup power and battery level is higher than 3.4V and lower than 3.6V
		12 V RS-232:	ON		
		USB interface:	ON		
		Relay:	ON/OFF		Light for 100 mS every 500 mS when UPiS Advanced is running on battery backup power and battery level is lower than 3.4V and higher than 3.2V
		RTC:	ON		
		System Monitoring:	ON		
		Script Machine:	ON		
LPR	**Low Powering**	**EPR Input:**	Disconnected	**USB**:	Not Light
		USB Input:	Disconnected	**EXT**:	Light
		RPi USB Input:	Disconnected	**BAT**:	Not Light/Light periodically (every LPRSTA)
		RPi Powering:	Not Powered	**CHG**:	Light only when battery is charging
		RPi Switch:	OFF/ON and SHDW	**STA**:	Not Light
		Battery:	Not charged		
		5VDC Output:	OFF	**STB**:	Not Light
		Analog Temp:	OFF/ON periodically (every LPRSTA)		
		1-wire:	OFF		
		12 V RS-232:	OFF		
		USB interface:	OFF		
		Relay:	OFF		
		RTC:	ON		
		System Monitoring:	OFF/ON periodically (every LPRSTA)		
		Script Machine:	OFF		
RPI	**RPi Powering**	**EPR Input:**	Disconnected	**USB**:	Light
		USB Input:	Disconnected	**EXT**:	Not Light
		RPi USB Input:	Disconnected	**BAT**:	Light
		RPi Powering:	ON	**CHG**:	Not Light/Light only when battery is charging
		RPi Switch:	ON	**STA**:	Blinking for 100 mS every 500 mS when cable power is connected
		Battery:	Auto/Intelligent Charging if needed		
		5VDC Output:	ON	**STB**:	Not Light (Light for 800 mS every 1 s within 40 s time frame

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	Analog Temp:	ON	when system is in File Safe Shutdown Procedure)
	1-wire:	ON if connected	
	12 V RS-232:	ON	
	USB interface:	ON	
	Relay:	ON/OFF	**THE RPI MODE IS NOT FULLY IMPLEMENTED YET**
	RTC:	ON	**WILL BE AVAILABLE IN NEXT FIRMWARE UPDATES**
	System Monitoring:	ON	
	Script Machine:	ON	

Additional Protected 5 VDC 140 mA output for user applications

Valid for the UPiS ADVANCED only

The RaspberryPi® can be used for an extremely wide range of applications. Many of them are using additional components that require powering. In order to support these range of application the **UPiS** offering a protected with PTC resettable fuse power output of 5 VDC. This output is normally battery backup as the whole system.

RaspberryPi ® Hardware ON/OFF Switch

Valid for the UPiS BASIC and UPiS ADVANCED

The RaspberryPi® Computer is a genius system. However due to cost reason some components are missing. One of them is the ON/OFF switch. Users sometimes like to switch their computer ON or OFF rather than unplugging the cable. In order to overcome this dysfunction the **UPiS** offer a hardware switch that completely isolates the powering from the RaspberryPi®. This functionality is available only when powering is going through the **UPiS** (the micro USB or the Extended External Power). It is not available if you are powering your RaspberryPi® from the original micro USB placed in the computer board.

Embedded on Board Analog Temperature Sensor accessible via RS232 interface

Valid for the UPiS BASIC and UPiS ADVANCED

The RaspberryPi® ICs as also **UPiS** are generating a heating by itself. It is important to the user to know at any time what temperature have the system and if is too high, take an action (i.e. switch off or start fan with embedded Relay). For that reason a simple analog thermometer has been implemented on the UPiS board. The value of the temperature can be read via RaspberryPi® RS232 port. The usage of it will be explained later, on this document. However it is very important to notice that a possibility to setup trigger on temperature is possible and make the activity on high or low temperature automatic and independent of the RaspberryPi®. For security reason the temperature of the UPiS cannot exceed the 60 Celsius due to battery life cycle. Therefore if temperature is higher than 60 Celsius the **UPiS** as the first step of protection stop the charging of the battery in order to reduce current consumption and if the temperature is still too high, start emergency shutdown procedure in order to save battery and after 40 seconds stop the powering to the RaspberryPi®.

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Basic System Operations

What is in the BOX?

Valid for the UPiS BASIC and UPiS ADVANCED

This package comes with everything you need to start using right out of the box the **UPiS**. It is assembled tested and consists all required accessories. A little work is necessary in order to setup the complete RaspberryPi® and **UPiS** in a single full operating system.

Each Box contains the following parts:

- The **UPiS** module assembled and tested
- A stick on the **UPiS** bottom side of battery, dual layer wide temperature adhesive tape (used for battery mounting)
- Set of necessary jumpers (yellow)
- Separate packed LiPO battery (1150 mAh for the **UPiS** Basic, and 2600 mAh for the **UPiS** Advanced)
- A male green connector used for the External Extended Powering – only for the **UPiS** Advanced
- A spare 1 Yellow Jumper

Please kindly notice that due to shipping regulations, LiPO batteries are packed in the same box but are physically separated and not connected to the **UPiS** module. It must be connected by the user, and it is a part of the installation procedure. Please also kindly notice that in order to increase the safety of usage of the **UPiS** module all sources of the unprotected power (mainly the enter point of the LiPO battery, and Extended External Power input voltage – 18VDC) are covered by a special isolation in order to avoid any damages of the device due to shortcuts made by improper use.

PICTURE

System Installation

Valid for the UPiS BASIC and UPiS ADVANCED

The installation procedure of the UPiS Modules is divided into the following phases:

- The Battery assembly with the UPiS Modules
- UPiS Module Jumpers check and setup (optional)
- Physical installation of the RaspberryPi®
- RaspberryPi® Software setup (optional)

Battery Assembly

Valid for the UPiS BASIC and UPiS ADVANCED

In order to install LiPo battery, you need to unpack it and connect the battery connector to the white connector on the PCB as shown on the picture.

PICTURE

In addition the battery cable should be conducted through the slot on the UPiS Modules PCB. Then protection from the wide temperature adhesive tape should be removed and battery should be glued on it. The following pictures show step by step above procedure.

PICTURE

UPiS Module Jumpers setup

Valid for the UPiS BASIC and UPiS ADVANCED

The **UPiS** module uses interfaces with the RaspberryPi® only via 2 pins trough the **P1** connector:

- 5V DC
- GND

All other pins are free to use and depending to the user needs. Selection of which pins are used is made using jumpers that connect **UPiS** selected add-ons peripherals to RaspberryPi®. Each peripheral can be controlled via selected jumper connecting it to the RaspberryPi® or via **UPiS** serial port using proper commands from a terminal program running on the RaspberryPi® or any other computer connected to the **UPiS**. Selection how the required UPiS Peripheral will be used is always made by a proper jumper set-up. The peripherals controlled by activated by Jumpers are listed here below:

UPiS Serial Ports Switching Matrix

Valid for the UPiS BASIC and UPiS ADVANCED

The system which is folded from the RaspberryPi® and the **UPiS** use for communication with external world and between them serial interfaces. There are:

- RaspberryPi® Serial Port
- UPiS Serial Port
- UPiS micro USB port
- UPiS RS232 Level Converter

Cross connectivity between them is extremely important in order to support to the user the best possible exploitation.

In order to achieve this goal there ware designed a Serial Ports Switching Matrix based on a jumper selection. A detailed description is provided below in a proper section below.

UPiS NO Relay Controls

Valid for the UPiS ADVANCED only

The **UPiS** Advanced offers a single low power Normally Open Relay. The outputs of its pins are placed on the screws free I/O 8 Pins Terminal: **RA** and **RB**. It is shown here below.

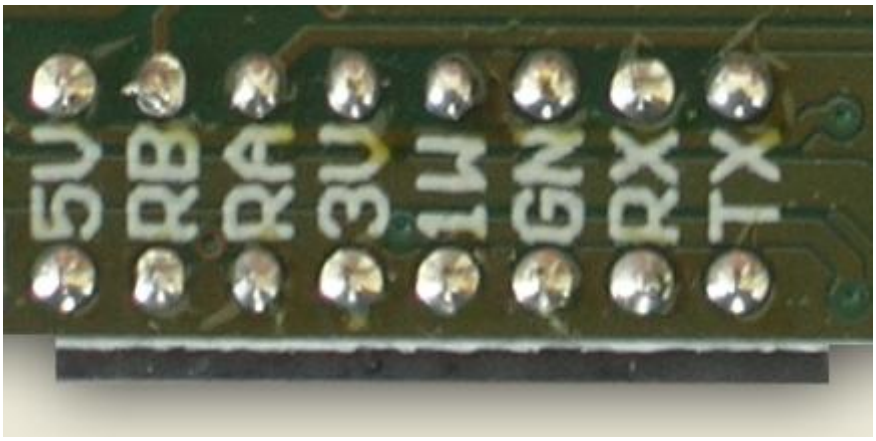

Figure 6 Top View - Screws free I/O 8 Pins Terminal

This NO Relay can be controlled by the **UPiS** commands through the terminal program or directly by the RaspberryPi® from a dedicated Pin GPIO_GEN0 (P1 Connector PIN 11). Selection what controls over the NO Relay is done via selection with a Jumper **S3** as shown on the picture here below.

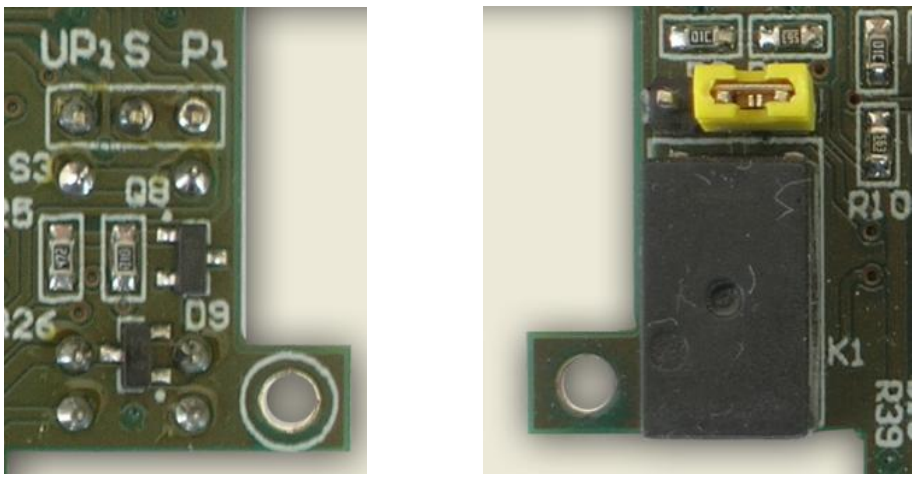

Figure 7 S3 Top and Bottom View – UPiS Control Selected

In a case that RaspberryPi® has been selected to control the NO Relay it is a user responsibility to write an appropriate script or program handling this Pin. In a case that UPiS

has been selected to control the NO Relay, it can be done via terminal from the RaspberryPi® or PC or any other application accessing the Serial Port on the RaspberryPi®. The appropriate commands to do it are:

- @RON – Relay ON (Close)
- @ROFF – Relay OFF (Open)

Battery cut-off jumper

Valid for the UPiS BASIC and UPiS ADVANCED

The integrated battery is equipped with a various security protections. One of them is the cut-off jumper – **P4**. The usage of this jumper is to galvanic isolate the battery from the **UPiS** system. There is important to note that by removing this jumper, battery is not charged, and the UPiS system is not supplying including RTC. Therefore opening of it is necessary only when **UPiS** is shipped via Air Plane for security reasons. For normal usage of the **UPiS** this jumper should be always closed.

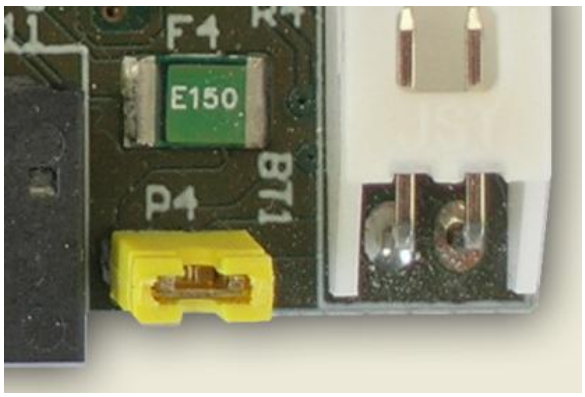

Figure 8 Bottom View Battery Cut-Off Jumper

1-wire selection Jumper

Valid for the UPiS ADVANCED only

The **UPiS** Advanced has an embedded interface for the 1-wire® sensors. This interface is ESD protected. This 1-wire interface can be controlled by the **UPiS** commands through the Terminal Program or directly by the RaspberryPi® from a dedicated Pin GPIO_GEN3 (P1 Connector PIN 15). Selection what controls over the 1-wire is done via selection with a Jumper **S2** as shown on the picture here below.

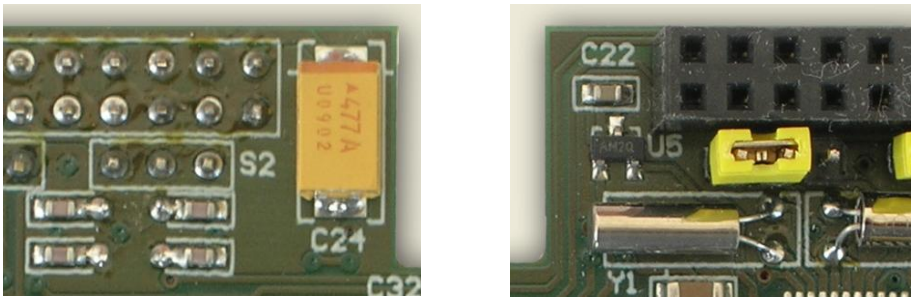

Figure 9 S2 Top and Bottom View – UPiS Control Selected

In a case that UPiS has been selected to control the 1-wire® interface, it can be done via terminal from the RaspberryPi® or PC or any other application accessing the Serial Port on the RaspberryPi®. The appropriate commands to do it are:

- @1WIREC - 1-wire® Temperature Celsius
- @1WIREF - 1-wire® Temperature Fahrenheit

In the future release of firmware our company is planning to release commands for the i-button® security key.

I²C Connection Jumpers (RTC)

Valid for the UPiS BASIC and UPiS ADVANCED

The **UPiS** is equipped with RTC which is supplied by the same battery with the rest of the system. The RTC is a software emulated DS1307. It communicates with the RaspberryPi® identical with the original DS1307. In order to have connectivity with the RTC user need to short 2 jumpers of the I^2C (the SDA and SDL). A detailed description how to use and set-up the **UPiS** RTC is described in another part. Here below is shown the connected I^2C to the RaspberryPi®. If user use another application where these pins are needed should left them free. Please kindly notice that it is possible to use multiple I^2C devices on the same bus.

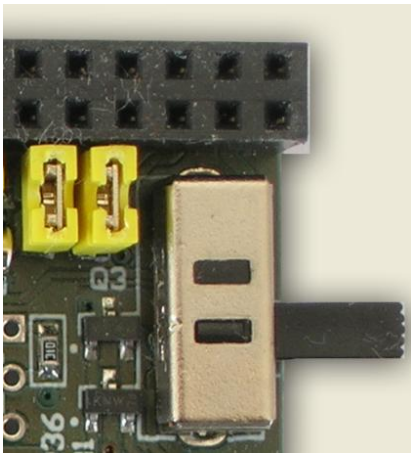

Figure 10 Bottom View - I^2C connected to the RaspberryPi

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File Safe Shutdown initiation Pin Jumper

Valid for the UPiS BASIC and UPiS ADVANCED

The File Safe Shutdown feature gives to the user a proper way to shutdown the RaspberryPi® by a single button pressing. However this procedure need to be recognized by the RaspberryPi® and for that reason a dedicated jumper need to be closed (set). If it will be open then the RaspberryPi® will never know that somebody request the shutdown of the system. The detailed procedure of the setting-up shutdown is described here below.

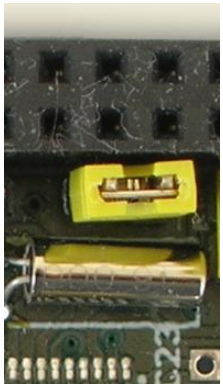

Figure 11 Bottom View the File Safe Shutdown Jumper

RaspberryPi® File Safe Shutdown Procedure and RaspberryPi® Reset

Valid for the UPiS BASIC and UPiS ADVANCED

In order to support the **File Safe Shutdown** procedure a simple script should be written and stored on the RaspberryPi®. There are many simple script written around this matter and can be easy find out over the internet, however we provide one examples that could be easy implement. Scripts could be divided into two basic categories:

- Interrupt based and
- Loop based.

User of the **UPiS** module is basically free to use their own script, however always should keep in mind some basics of the implemented circuit on the **UPiS** board:

- There are no Pull-Up resistors on the **UPiS** board therefore user need to setup the RaspberryPi® resistors
- The Pin which has been dedicated to this task is the pin GPIO.27
- Before this functionality will be used user need to put a proper jumper on the **UPiS** Board otherwise it will be not working as the input pin GPIO.27 is continuously scanning it to see if low state is.

- If user does not need this functionality or need this pin, the pin GPIO.27 could be used for other applications; the associated jumper should be open (removed).

There are two basic functionalities associated with the **Shutdown Button.** There are:

- Reset Functionality
- File Safe Shutdown (if a proper script is applied to the RaspberryPi®)

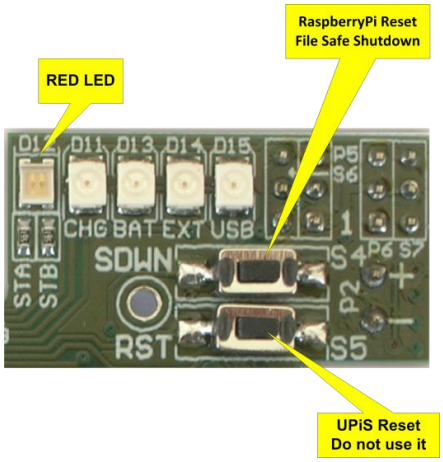

Figure 12 Top View SDWN and RST Buttons

The **Reset Functionality**, is executed when the **Shutdown Button** is pressed for a longer time than 0.3 second and shorter than 2 second. In practice, it means that user need to press the button, little bit longer and then leaves it up. Then the **UPiS** module will cut immediately power of the RaspberryPi® for a 1 second and then power it again. This cutting of power is like a rest and immediately stops all functionalities of the RaspberryPi®.

Please kindly notice that using of this functionality can cause of file system destroy in the SD card, therefore it is **STRONGLY RECOMMENDED** to use it ONLY if the RaspberryPi® does not response to any input device.

The **File Safe Shutdown Functionality** does not have this limitation, and safe files from any corruption. It is executed when the **Shutdown Button** is pressed for a longer time than 2 seconds. In order to simplify usage of it, when UPiS Module recognize pressed button for the **File Safe Shutdown** lights the RED led for 1 second, and then flash it every second for 800 ms. In practice, it means that user need to press the button until RED led light and release it just after that. Following will see the flashing RED led. This is optical information that **File Safe Shutting** down procedure has been initiated and is in progress. It takes 40 seconds (on the **UPiS** module), and after that you will see that RaspberryPi® has been stop. If you have initiated terminal on the RaspberryPi® or connected other computer via USB you will see also the following messages on the screen.

UPiS System Stared File Safe Shutdown Procedure

And when finished the shutting down

UPiS System Finished File Safe Shutdown Procedure

Here below is described the simple procedure how to implement the simplest Python script used for the **Safe File Shutdown**.

Open Terminal from the command line or open an LXTerminal session, and use the Nano text editor to add some code to enable the Python script created to run when the RaspberryPi® boots up. Type in:

sudo nano /etc/rc.local

and then add in the following code:

sudo python /home/pi/upis/fshut.py

before the line that says:

exit 0

Press Ctrl+X to exit the Nano editor and when prompted press Y and then Enter in order to save the file you just edited.

Next prepare the directory where the script will be place i.e. “upis” using the following command:

mkdir upis

Using nano editor write the following script and save on pre-prepared directory “upis” with a name fshut.py

```
sudo nano /home/pi/upis/fshut.py
```

The screen below shows the script that need to be entered using nano.

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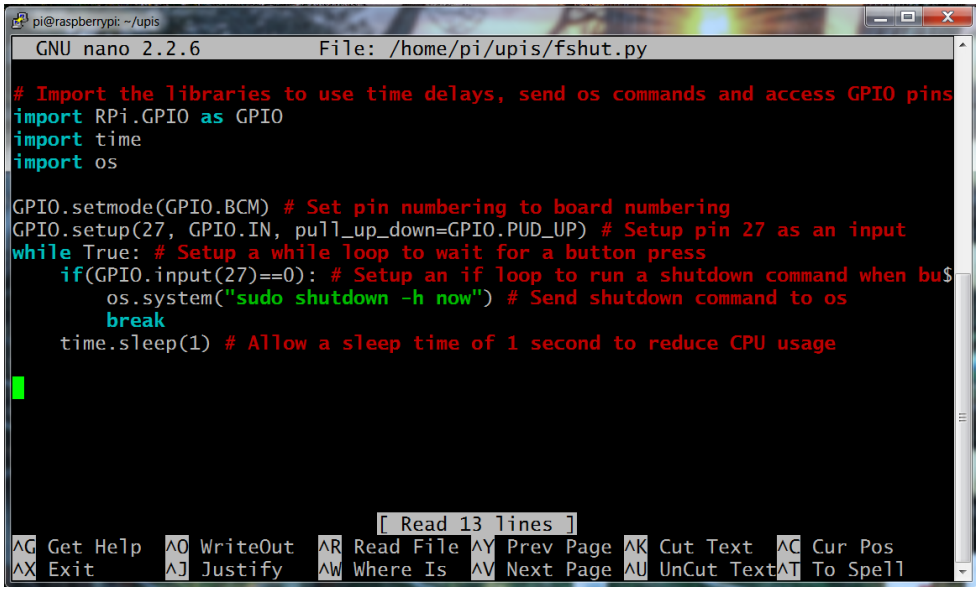

pi@raspberrypi: ~/upis
GNU nano 2.2.6 File: /home/pi/upis/fshut.py
# Import the libraries to use time delays, send os commands and access GPIO pins
import RPi.GPIO as GPIO
import time
import os
GPIO.setmode(GPIO.BCM) # Set pin numbering to board numbering
GPIO.setup(27, GPIO.IN, pull_up_down=GPIO.PUD_UP) # Setup pin 27 as an input
while True: # Setup a while loop to wait for a button press
if(GPIO.input(27)==0): # Setup an if loop to run a shutdown command when bu$
os.system("sudo shutdown -h now") # Send shutdown command to os
break
time.sleep(1) # Allow a sleep time of 1 second to reduce CPU usage
[Read 13 lines]
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell

Figure 13 File Safe Shutdown Python Script - fshut.py

```
# Import the libraries to use time delays, send os commands and access GPIO pins
import RPi.GPIO as GPIO
import time
import os

GPIO.setmode(GPIO.BCM) # Set pin numbering to board numbering
GPIO.setup(27, GPIO.IN, pull_up_down=GPIO.PUD_UP) # Setup pin 27 as an input
while True: # Setup a while loop to wait for a button press
  if(GPIO.input(27)==0): # Setup an if loop to run a shutdown command when button press sensed
        os.system("sudo shutdown -h now") # Send shutdown command to os
        break
  time.sleep(1) # Allow a sleep time of 1 second to reduce CPU usage
```

You can easy check if your script is running just writing on the command line

```
sudo python /home/pi/upis/fshut.py
```

and then pressing the **Shutdown Button** for more than 2 seconds (until RED led will light on). If you are done properly your above tasks, the computer should print on the screen the following message and shutdown then.

The system is going down for system halt NOW!

After the **Safe File Shutdown** you can restart your RaspberryPi® using the **Reset Functionality**. This is the proper way of restarting you computer when using the **UPiS** module, because removing cable activated battery back-up, **and do not stop the system**. After shutdown of the RaspberryPi® it is recommended to switch off the computer using the hardware switch placed on the **UPiS** PCB. If the system is supplied from battery power back-

up then it will goes automatically to Low Power Mode. This functionality will be also available for the Cable Powering in future Firmware Updates.

Therefore there are the following ways to switch of the RaspberryPi®:

1. Safe File Shutdown (without risk of corrupted files)
2. Switch Off the system with the integrated mechanical switch (with a risk of files corruption)

Superior System Operations

UPiS Firmware Upgrade Procedure

Valid for the UPiS BASIC and UPiS ADVANCED

In order to keep **UPiS** module firmware up-to-date an embedded serial bootloader has been implemented. Invoking it is done when the UPiS module starts from **UPiS** RESET with pressed at the same time **SHDN** button. This feature allows user to update the firmware trough the micro USB port placed on the **UPiS** module. In order to upload the new firmware to the **UPiS** dedicated bootloader software needs to be running on the PC. Current version of the boot loader supports only Windows® Operating System. For the UPiS Firmware Update Procedure will be needed:

1. Personal Computer with Windows® OS
2. Micro USB to USB cable
3. The bootloader program. You need to download the bootloader software file with a name UPiS_bootloader.zip from the following location:

   http://www.pimodules.com/downloads/UPiS_bootloader.zip

   Save to a known location on your PC and unzip it to a folder i.e. c:\UPiS\. Unzipping of this file will generate:
   i. UPiS_BL.exe
   ii. UPiS_Bootloader.bat

4. The latest Hex file of the firmware. You need to download the latest UPiS firmware file with a name UPiS_firmware_v1.00.zip from the following location:

   http://www.pimodules.com/downloads/UPiS_firmware_v1.00.zip

   Save to a known location on your PC and unzip it to a folder i.e. c:\UPiS\. Unzipping of this file will generate:
   i. UPiS_V1.00.hex
   ii. UPiS_V1.00_recent_changes.txt

5. Any Terminal program running on the PC (i.e. TearTerm, HyperTerminal or any other). It must be set to 38400 8N2, to make it connection with the **UPiS**

6. The **UPiS** module itself

The UPiS_BL.exe need to be call from the COMMAND PROMPT with the following parameters:

UPiS_BL PORT=COMX BAUD=38400 UPiS_V1.00.hex

Where:

PORT=COMX is the Virtual Com Port which has been recognized by the Windows® OS when UPiS is connected to the PC USB Port (i.e. COM1, COM2 etc).

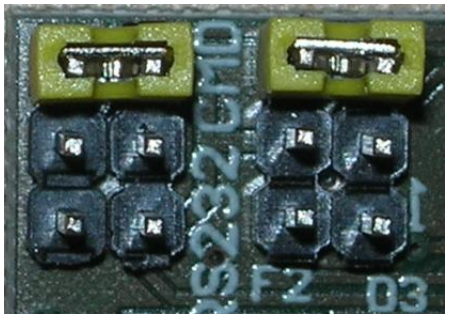
BAUD=38400 is the data rate in which UPiS communicate with the system. Do not change it.

UPiS_V1.00.hex is the latest firmware update file

However, because calling of this software need to be done from the COMMAND PROMPT it can cause some troubles for none experienced users. There is another way to use of it, probably simpler than the first one. This is by running the **UPiS_Bootloader.bat**. It can be done from the graphic environment, just by clicking it. However, before do it, must be edited with a notepad, and adopted parameters about the COM port, and probably the .HEX file.

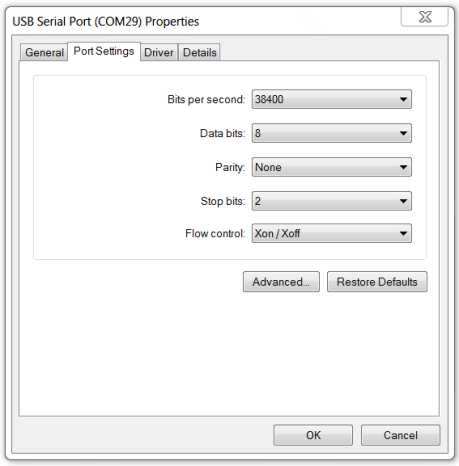
After downloading and adopting the software, the next step is to upload the latest firmware to the **UPiS** module. Here below is described step by step the firmware updating procedure:

1. Shutdown the RaspberryPi® if it is running using File Safe Shutdown Procedure
2. After that, switch OFF the powering of the RaspberryPi® with mechanical switch of the **UPiS**
3. It would be also good idea to unplug completely the RaspberryPi® however it is not necessary, and depends of the Jumper setting you have already set. If you need to set Jumpers, it is better to unplug the RaspberryPi® from the **UPiS**. The most important is to completely isolate powering of the RaspberryPi® from the **UPiS** module.
4. Set the proper Jumpers in the Serial Ports Connection Matrix
5. Selected connection should be: **UPiS** Serial Port routed to the **UPiS** micro USB Connector

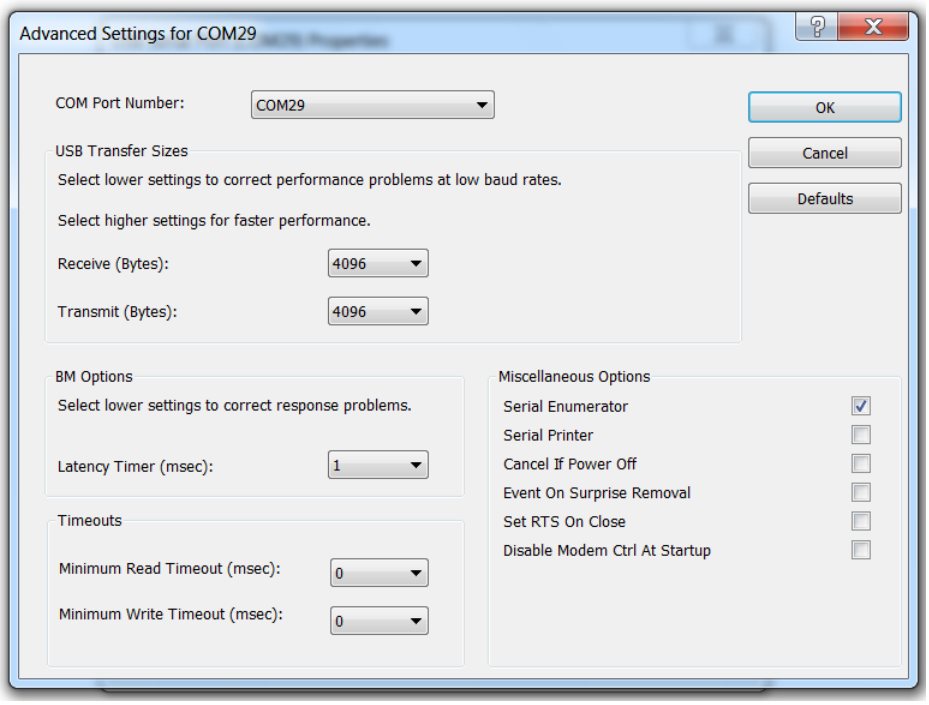


6. Connect the **UPiS** module through their micro USB socket to USB socket in your PC via cable
7. Be sure that **UPiS** is connected through their micro USB to computer and powered via the same port
8. The UPiS micro USB should be recognized by the Windows® OS and Virtual Com Port should be assigned. If you doing that for the first time it could take little bit longer because Windows® OS will install automatically the required driver.
9. Using Device Manager check the Virtual Com Port number assigned to the **UPiS** USB connection i.e. COM29
10. Set the following parameters on the Virtual Com Port:

    Bit per Second: 38400
    Data Bits: 8
    Parity: NONE
    Stop Bits: 2
    Flow Control: XON/XOFF



In the Advanced Tab make the following changes



Latency Timer: 1

11. You should know the Virtual Com Port in order to use it with the **UPiS_BL.exe** bootloader software.
12. To invoke the bootloading procedure on the **UPiS** press the **RST** button, and after that (having pressed the **RST** button) the **SDWN**, and after that, release the button **RST** (having pressed the **SDWN** button), release the **SDWN** button. You will have all Green LEDs light, and then (STB) RED Light. Your **UPiS** is now in the **bootloading** mode and waiting for the hex file. This procedure can be easy done with one finger due to close placement of these two buttons.

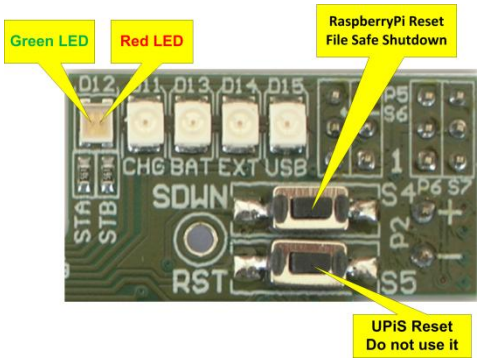
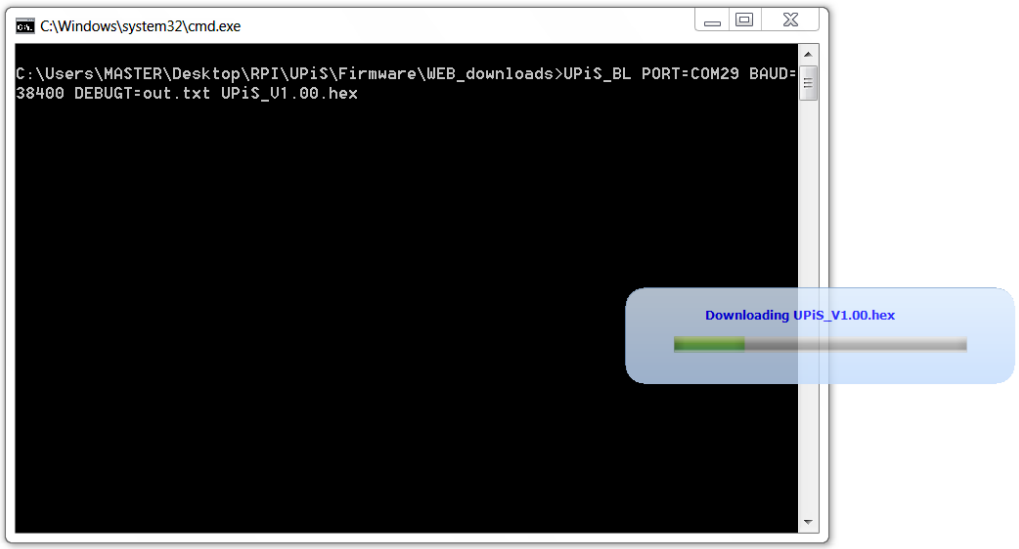


Figure 14 Top View Bootloader LEDs (Green and Red), SDWN and RST Buttons

13. Be sure that the Terminal program is not running because you will have a conflict with the Virtual Com Ports when **UPiS_BL.exe** will be called

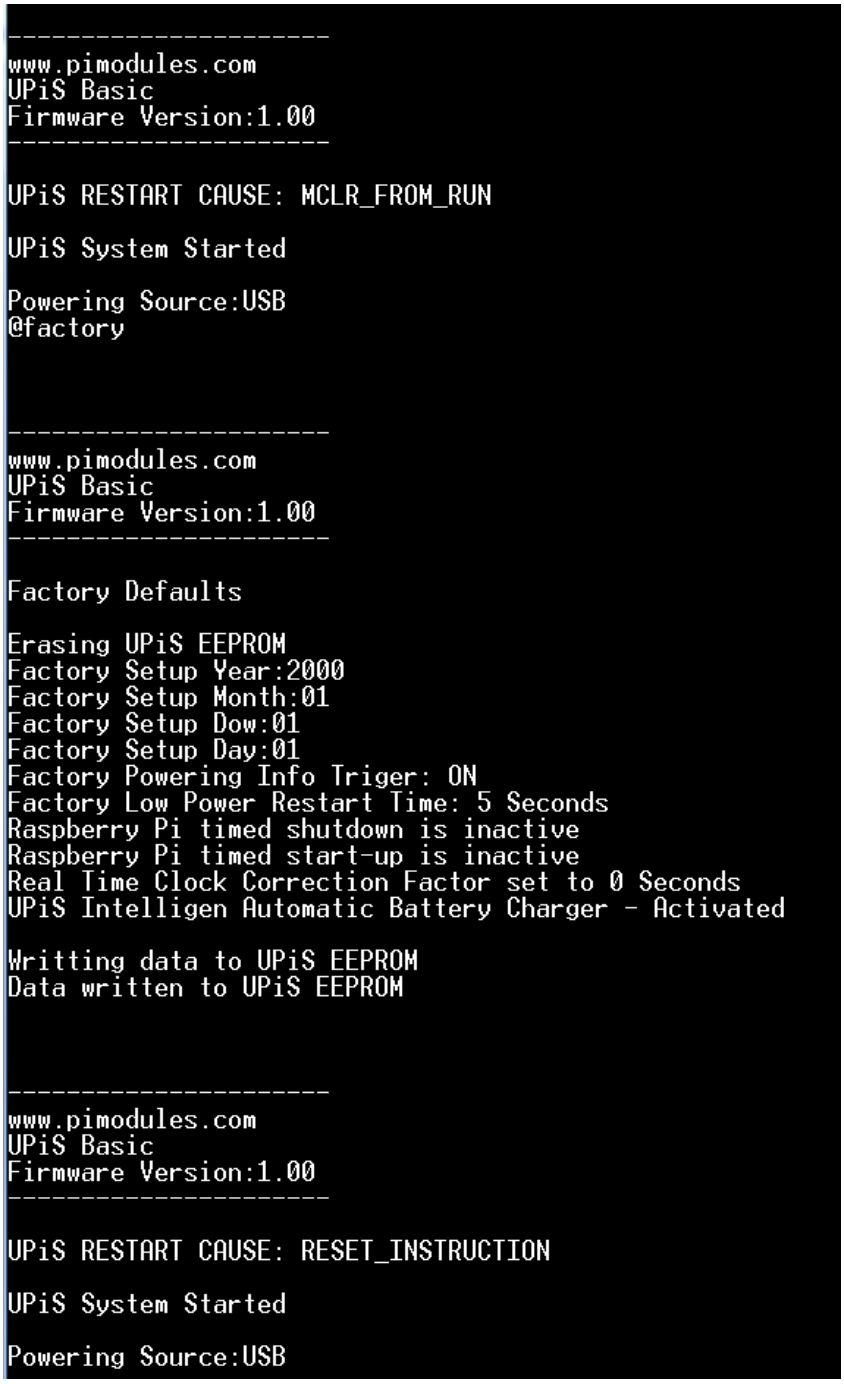
14. Run the **UPiS_BL.exe** with required parameters from the COMMAND PROMPT or the modified **UPiS_Bootloader.bat**
15. When you start it, the **(STB) RED** led will be switched to **(STA) Green** and you will see the following picture on the screen.



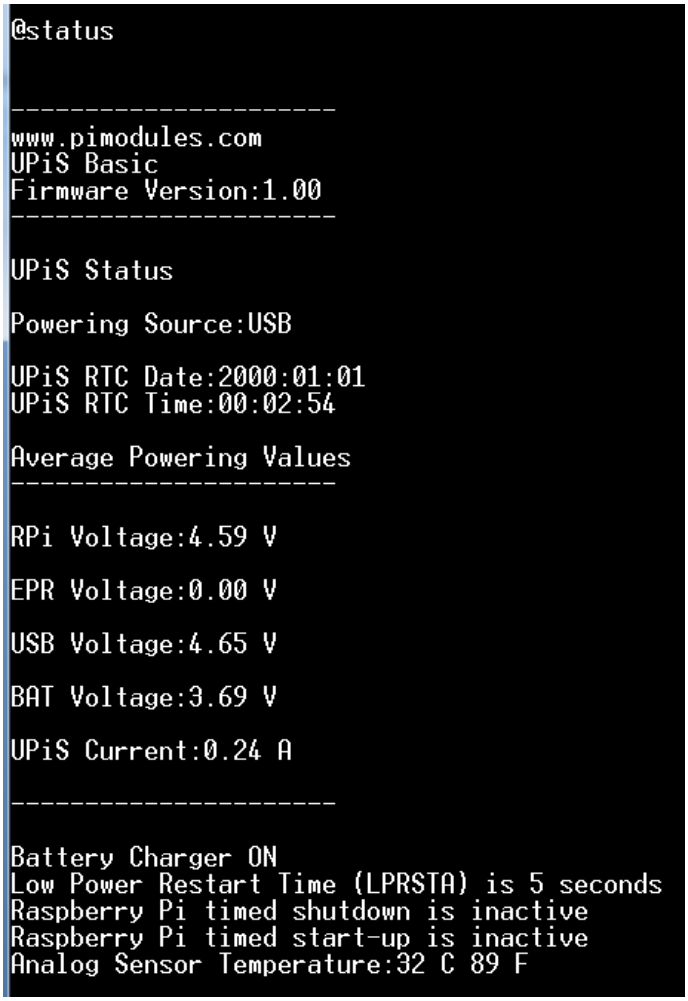
16. The Firmware uploading procedure takes about 30-40 seconds, after that **UPiS** Restarts

17. **It is very important after latest firmware update, with connected UPiS to your PC, to run Terminal Program, select the proper COM port press the RST button, see messages sent by UPiS to the Terminal and type the command @FACTORY to set the factory defaults**

18. The following picture will be visible on the terminal screen:



There is also a good idea to run the command @status in order to see the **UPiS** Status



After that the **UPiS** will be ready to use it with the RaspberryPi®.

There is only on firmware available for both types of **UPiS Basic** and **UPiS Advanced.** The firmware automatic recognize on which type of board is running and automatically selects the available futures.

Routing the Serial and USB Ports

Valid for the UPiS BASIC and UPiS ADVANCED

Both versions of **UPiS modules** are equipped with micro USB interface (for powering and for data transfer) as also the **UPiS Module Advanced** is in addition equipped with RS232 Level Converter. These interfaces are designed in a way that allows connectivity between various serial links of the pair **UPiS** module and RaspberryPi®. In order to allow these various types of connectivity a Switching Matrix has been implemented. It is a set of jumpers that with a selectable configuration forced various connectivity schemes. There are:

1. Routes RaspberryPi® RS232 to the UPiS Module micro USB Connector

Valid for the UPiS BASIC and UPiS ADVANCED

This setting routes the RS232 RaspberryPi® RS232 to the UPiS Module micro USB connector allowing viewing on the PC their I/O. The user can change access of this interface in the RaspberryPi® in order to use it on their applications, but it can be used also for Emergency Recovery of the RaspberryPi®. The proper settings of the jumpers are shown here below. The RS232 of the RaspberryPi® is set to the 115200 bps 8N1, so terminal program on the PC should be set to the same rate and other parameters.

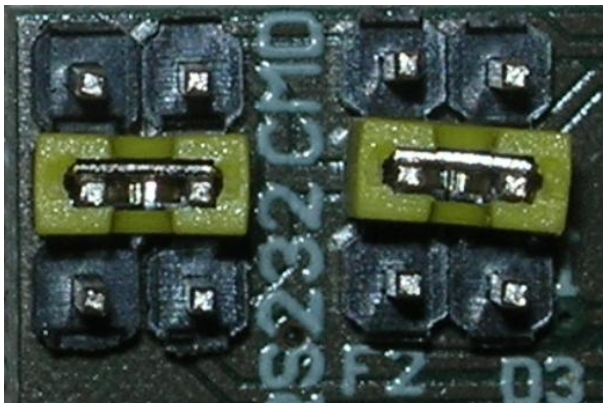


Figure 15 RaspberryPi® RS232 connected to the UPiS Module micro USB

Disabling the Recovery use of the RaspberryPi® RS232 is explained in details in the next sections and should be done if user plans to use this port for any other application than rescue procedure.

2. Routes RaspberryPi® RS232 to RS232 UPiS Level Converter

Valid for the UPiS ADVANCED only

Similar as in the (1) the RS232 of the RaspberryPi® can be routed to the **UPiS** RS232 level converter instead to the **UPiS** micro USB interface. Usage is similar to the described above. This functionality is available only in the **UPiS** Advanced.

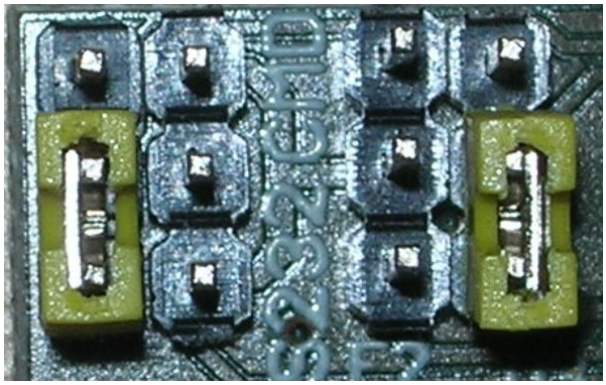


Figure 16 RaspberryPi® RS232 connected to RS232 UPiS Level Converter

3. Route RaspberryPi® RS232 to UPiS Serial Port

Valid for the UPiS BASIC and UPiS ADVANCED

The **UPiS** Advanced and **UPiS** Basic are equipped with their own serial port. This port is used to control the **UPiS** from a terminal program. There is a long list of commands available to control the **UPiS**. If user like to control the UPiS from their RaspberryPi® need to connect the **UPiS** serial port to the RaspberryPi® serial port. A detailed description how to make it in the RaspberryPi® is provided in another point of this manual. However independent from the setting on the RaspberryPi® there must be also a physical connection between UPiS and RaspberryPi®, which must be done by setting the proper jumpers like in the picture below.

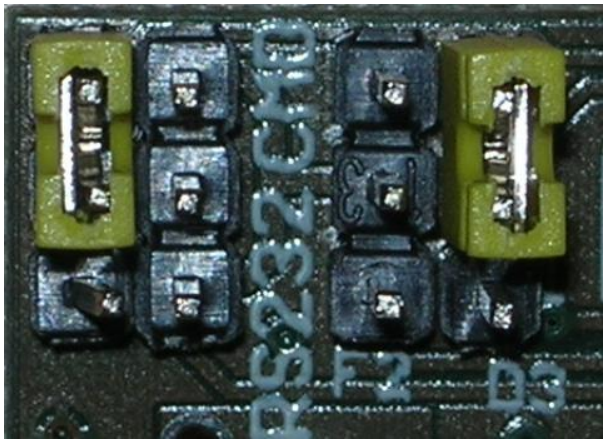


Figure 17 RaspberryPi® RS232 connected to UPiS Serial Port

4. UPiS Serial Port to the UPiS USB Connector

Valid for the UPiS BASIC and UPiS ADVANCED

This setting is similar to the (3) however routes the UPiS serial port to the UPiS micro USB. It is used for the firmware bootloading, for debugging purposes or just have a control over the UPiS via terminal running on PC.

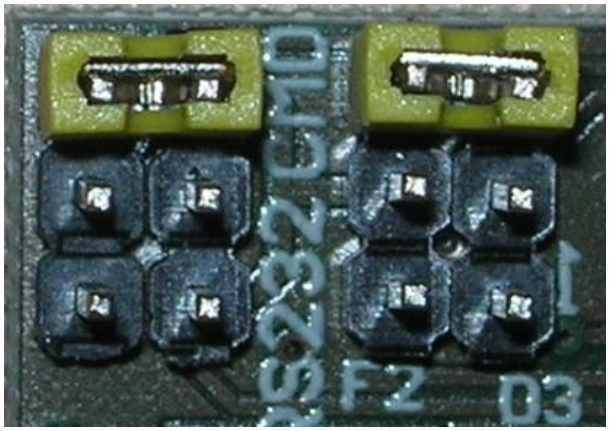


Figure 18 UPiS Serial Port connected to the UPiS USB Connector

5. **RS232 Level Converter Port to the UPiS USB Connector**
   Valid for the UPiS ADVANCED only
   The **UPiS** RS232 level converter and **UPiS** micro USB are completely independent hardware on the board of the UPiS. Therefore it can be connected and used according to jumper setting. Sometime there is a need to have independent USB to Serial converter. This configuration of jumpers make exactly this thing – an independent USB to RS232 converter that can be used in the application built based on RaspberryPi®.

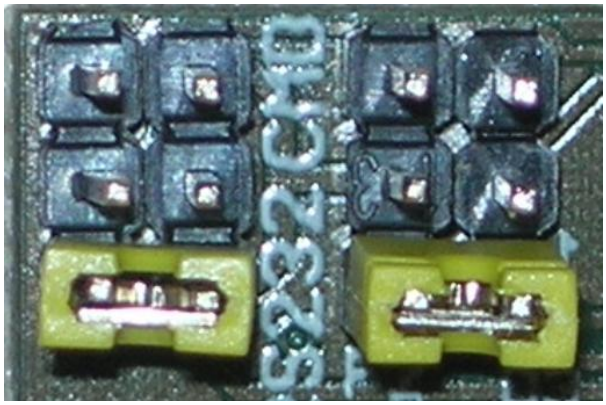


Figure 19 RS232 Level Converter Port connected to the UPiS USB Connector

UPiS Terminal Commands Control

Valid for the UPiS BASIC and UPiS ADVANCED

The **UPiS** is a Plug and Play device in their basic functionality. After assembly of the battery and connection with RaspberryPi® there is no need for any additional maintenance in order

to use most of features. However there is a group of users that have more advanced needs. The **T**erminal **C**ommands **C**ontrol is addressed to them. The **TCC** give to such user a plenty of additional features all in a single board. Some of them can be accessed directly from the RaspberryPi® Pins by using jumpers' selection, but all of them can be accessed from a single access point the RaspberryPi® RS232 port connected directly to the **UPiS** Serial Port. This can be done simple by a terminal program or by software written in any language (C, Python etc) that has an access to the RaspberryPi® Serial Port. Here below will be presented all commands as also how to make necessary changes in the RaspberryPi® in order to use their serial port by user application. Writing software to handle the serial port in various languages is not a part of this manual, therefore all command will be presented how can be handled from the terminal program.

In addition if the UPiS Serial Port will be routed to the UPiS micro USB interface this functionality can be handle also from a PC and associated Terminal Program (i.e. TeraTerm). Then it is not necessary to make any modifications to the RaspberryPi® Serial Port usage.

Setting Up the RaspberryPi® Serial Port

Valid for the UPiS BASIC and UPiS ADVANCED

By default the RaspberryPi®'s serial port is configured to be used for console input/output. Whilst this is useful if you want to login using the serial port, it means you can't use the Serial Port in your programs. To be able to use the serial port to connect and talk to other devices the serial port console login needs to be disabled.

Needless to say you will need some other way to login to the RaspberryPi®, it is suggested doing this over the network using an SSH connection.

Disable Serial Port Login

To enable the serial port for your own use you need to disable login on the port. There are two files that need to be edited

The first and main one is:

/etc/inittab

This file has the command to enable the login prompt and this need to be disabled. Edit the file and move to the end of the file. You will see a line similar to:

T0:23:respawn:/sbin/getty -L ttyAMA0 115200 vt100

Disable it by adding a # character to the beginning. Save the file.

#T0:23:respawn:/sbin/getty -L ttyAMA0 115200 vt100

Disable Bootup Info

When the RaspberryPi® boots up, all the bootup information is sent to the serial port. Disabling this bootup information is optional and you may want to leave this enabled as it is sometimes useful to see what is happening at bootup. If you have a device connected (i.e. Arduino) at bootup, it will receive this information over the serial port, so it is up to you to decide whether this is a problem or not.

You can disable it by editing the file:

/boot/cmdline.txt

The contents of the file look like this

dwc_otg.lpm_enable=0 console=ttyAMA0,115200 kgdboc=ttyAMA0,115200 console=tty1 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline rootwait

Remove all references to ttyAMA0 (which is the name of the serial port). The file will now look like this:

dwc_otg.lpm_enable=0 console=tty1 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline rootwait

Reboot

In order you enable the changes you have made, you will need to reboot the Raspberry Pi

sudo shutdown -r now

Test the Serial Port

A great way to test out the serial port is to use the minicom program. If you don't have this installed run

sudo apt-get install minicom

Connect your PC to the RaspberryPi® via Virtual Serial Port using an appropriate jumpers setting (**RaspberryPi® RS232 to the UPiS Module micro USB Connector)**,

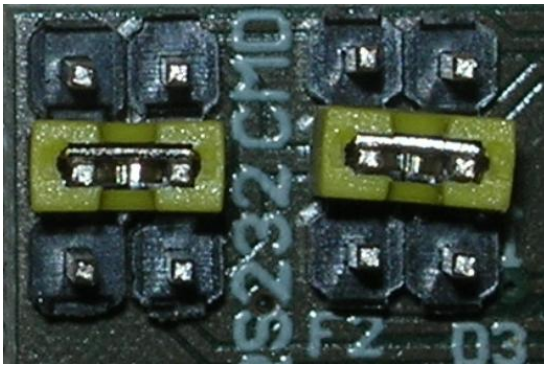


Figure 20 RaspberryPi® RS232 connected to the UPiS Module micro USB

then open TeraTerm or a similar serial terminal program on PC side. Setup a connection using the serial port at 38400 baud.

Now run up minicom on the Raspberry Pi using

minicom -b 38400 -o -D /dev/ttyAMA0

What you type into the minicom terminal screen should appear on the serial PC terminal and vice versa.

UPiS Terminal Commands Set

Valid for the UPiS BASIC and UPiS ADVANCED

In order to simplify the **UPiS TCC** string parsing each command send to **UPiS** are ALWAYES start with sign of **@**. Here below is the list with detailed explanation of command implemented until now. Please kindly notice that we are working on more commands (functionalities) that will be released soon with the next firmware releases.

COMMAND: @FACTORY

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Factory Defaults.

Usage: **@factory** or **@FACTORY**

Results/Explanation: Return UPiS to Factory Default Values. Should be used always after upload of a new firmware.

COMMAND: @VERSION

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Print the Version

Usage: @version or **@VERSION**

Results/Explanation: Return **UPiS** Hardware and Firmware Version

COMMAND: @STATUS

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Print the UPiS Status

Usage: @status or **@STATUS**

Results/Explanation: Return **UPiS** detailed status that contains all needed parameters of the system like: powering source, Voltages, Current, and Analog Temperature etc.

COMMAND: @RON

Valid for the UPiS ADVANCED only

Meaning: Normally Open Relay switch ON

Usage: @ron or **@RON**

Results/Explanation: Switch the NO Relay ON

COMMAND: @ROFF

Valid for the UPiS ADVANCED only

Meaning: Normally Open Relay switch OFF

Usage: @roff or **@ROFF**

Results/Explanation: Switch the NO Relay OFF

COMMAND: @ANTMPC

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Print the UPiS Analog Thermometer Temperature

Usage: @antmpc or **@ANTMPC**

Results/Explanation: Return **UPiS** Analog Thermometer Temperature in Celsius

COMMAND: @ANTMPF

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Print the UPiS Analog Thermometer Temperature

Usage: **@antmpf** or **@ANTMPF**

Results/Explanation: Return **UPiS** Analog Thermometer Temperature in Fahrenheit

COMMAND: @PM

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Powering Mode

Usage: **@pm** or **@PM**

Results/Explanation: Return **UPiS** actual Powering Mode. There are:

- **USB** - **USB** Cable Powering
- **EPR** - **E**xternal Cable **P**owe**R**ing
- **BAT** - **Bat**tery Powering
- **LPR** - Battery **L**ow **P**ower**i**ng
- **RPI** - **RPi** Powering

COMMAND: @ CHGR ON/OFF

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Switch Automatic Intelligent Charger OFF or ON

Usage: **@chgr on** or **@CHGR ON**

Usage **@chgr off** or **@CHGR ON**

Results/Explanation: Switches the Automatic Intelligent ~~LiPO~~LiPo battery Charger ON or OFF. It is necessary sometimes when you are supplying the RaspberryPi® from a power source with reduced current availability like user PC USB interface. Under normal conditions UPiS check all the time system current consumption and when it is bigger than 750 mA, then it is switching OFF the charger, but sometimes the available current is not enough and is below it, therefore user need to close the battery charging completely. The UPS feature will be still active even if battery is not charged.

COMMAND: @RPI

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Voltage on the RaspberryPi® 5V P1 connector

Usage: **@rpi** or **@RPI**

Results/Explanation: Return the actual exact value of the RaspberryPi® 5V voltage P1 connector

COMMAND: @EPR

Valid for the UPiS ADVANCED only

Meaning: Voltage on the External Extended Powering connector (7 V DC – 18 V DC)

Usage: **@epr** or **@EPR**

Results: Return the actual exact value of the Voltage on the External Extended Powering connector (7 V DC – 18 V DC)

COMMAND: @USB

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Voltage on the UPiS micro USB connector

Usage: **@usb** or **@USB**

Results/Explanation: Return the actual exact value of the voltage on the UPiS micro USB connector

COMMAND: @BAT

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Voltage on the UPiS Battery

Usage: **@bat** or **@BAT**

Results/Explanation: Return the actual exact value of the voltage on the UPiS Battery

COMMAND: @CUR

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: System Current Consumption

Usage: **@cur** or **@CUR**

Results/Explanation: Return the actual exact value of the UPiS and RaspberryPi® system current consumption

Accuracy - 10mA

The measurement contains:

- The RaspberryPi® current consumption
- Battery Charging current consumption
- Relay ON current consumption
- Microcontroller current consumption
- RS232 Level Converter current consumption
- Serial Bridge current consumption
- UPiS LEDs current consumption
- Various Components of the UPiS current consumption

There is a working version that will be released soon with a new firmware, showing separated current consumption of the RaspberryPi® and UPiS

COMMAND: @1WIREC

Valid for the UPiS ADVANCED only

Meaning: Print the 1wire sensor Thermometer Temperature

Usage: **@1wirec** or **@1WIREC**

Results/Explanation: Return **1wire sensor** Thermometer Temperature in Celsius with accuracy of 0.1 degree in Celsius

COMMAND: @1WIREF

Valid for the UPiS ADVANCED only

Meaning: Print the 1-wire® sensor Thermometer Temperature

Usage: **@1wiref** or **@1WIREF**

Results/Explanation: Return **1-wire® sensor** Thermometer Temperature in Celsius with accuracy of 0.1 degree in Fahrenheit

COMMAND: @ PWRINFO ON/OFF

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Set ON/OFF the Automatic Trigger when Powering Source is changing

Usage: **@pwrinfo on** or **@PWRINFO ON**

Usage: **@ pwrinfo off** or **@ PWRINFO OFF**

Results/Explanation: If set to ON every time when powering source is changed send a message. It is very useful to know for some remote application automatically when powering source has been changed

COMMAND: @ LPRSTA

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Low Powering Restart Sampling Time

Usage: **@lprsta <number 1-99>** or **@LPRSTA <number 1-99>**

Usage: **@lprsta** or **@LPRSTA**

Usage: **@lprsta ?** or **@LPRSTA ?**

Results/Explanation: Return or set the Low Power Return Time.

When System of UPiS and RaspberryPi® are supplied from battery if the user shutdown it using the **File Safe Shutdown Procedure**, or just switch off using mechanical switch, then after couple of second the UPiS is going to the Low Powering Mode (sleeping mode) where the current consumption is very small. Usual the UPiS consume during the LPR mode about 60 – 70 uA and the only running peripheral during that time is the RTC. The recovery from this mode is possible in two ways:

- By pressing the SHDN button
- By switching the mechanical switch or
- By entering Cable Power

However, because the UPiS is in very Low Powering Mode most of the peripherals are not working - are sleeping and not consuming current. Therefore the UPiS needs to stand up periodically, supply the peripherals, make some measurements in order to see what is going on around it (i.e. if Cable Power has been entered, RaspberryPi® switched ON and consuming current etc.). These checks of peripherals take 9 mS, and consume 300 uA. The time how often it is done is the LPRSTA time. The default value is 5 second, and that means that every 5 second UPiS stand-up for a 9 mS, check their peripherals, and if nothing happen, then going to sleep again, if restart even happen (listed above) goes out from the LPR mode and start sunning as before. Because during stand-up consumption of current is much higher, user can adjust how often it will happen in order to safe battery (energy).

Examples:

@LPRSTA 10 (means that even if put the Cable to USB it will be recognized after 10 seconds, and then the system starts-up)

COMMAND: @TIME

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Shows the current UPiS RTC TIME

Usage: **@time** or **@TIME**

Results/Explanation: Return the TIME of the UPiS RTC

COMMAND: @DATE

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Shows the current UPiS RTC DATE

Usage: **@date** or **@DATE**

Results/Explanation: Return the DATE of the UPiS RTC

COMMAND: @START

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Startup RaspberryPi® after X minutes

Usage: **@start** or **@START**

Disable the START timer procedure (reset the START timer to 0)

Usage: **@start ?** or **@START ?**

Show the set value of the START timer

Usage: **@start !** or **@START !**

Show the current value of the running START timer. This timer is decreasing until reaches value of 0 and then startup the RaspberryPi®

Usage: **@start <number>** or **@START <number>**

Set the current value of the START timer. The <number> must be from 2 up to 1000 minutes

Results/Explanation:

A detailed explanation is in here below together with the @STOP command

COMMAND: @STOP

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Shutdown RaspberryPi® after X minutes

Usage: **@stop** or **@STOP**

Disable the STOP timer procedure (reset the STOP timer to 0)

Usage: **@stop ?** or **@STOP ?**

Show the set value of the STOP timer

Usage: @stop ! or @STOP !

Show the current value of the running STOP timer. This timer is decreasing until reaches value of 0 and then shutdown using File Safe Shutdown Procedure the RaspberryPi®

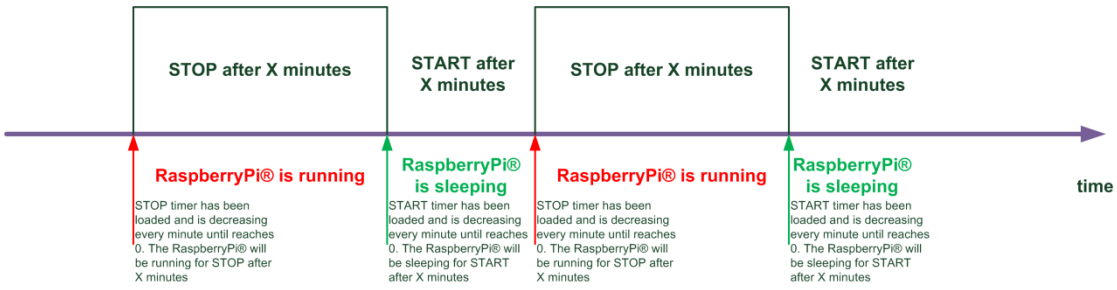
Usage: @stop <number> or @STOP <number>

Set the current value of the STOP timer. The <number> must be from 2 up to 1000 minutes

Results/Explanation:

There are many applications especially when running the RaspberryPi® on battery supply when user needs to start it for a short time do something; and then after predefined time shutdown it. This approach is ideal when power is not enough, therefore stopping and running the RaspberryPi® save a lot of energy.

The START and STOP command predefine two timers that counts running and sleeping time. Each timer starts when the other is stopped. IN order to have running this system both values START and STOP should be set. The UPiS executes always first the STOP after X minutes command. Both values are stored in the UPiS EEPROM, therefore it wills run as far the system is connected to the RaspberryPi®.


STOP after X minutes
START after X minutes
STOP after X minutes
START after X minutes
RaspberryPi® is running
STOP timer has been loaded and is decreasing every minute until reaches 0. The RaspberryPi® will be running for STOP after X minutes
RaspberryPi® is sleeping
START timer has been loaded and is decreasing every minute until reaches 0. The RaspberryPi® will be sleeping for START after X minutes
RaspberryPi® is running
STOP timer has been loaded and is decreasing every minute until reaches 0. The RaspberryPi® will be running for STOP after X minutes
RaspberryPi® is sleeping
START timer has been loaded and is decreasing every minute until reaches 0. The RaspberryPi® will be sleeping for START after X minutes
time

Examples:

@START 5 (means sleep for 5 minutes and then startup)

@STOP 3 (means run for 3 minutes and then shutdown)

Means that system will shut down after 3 minutes then will be sleeping for 5 minutes and then start up and running for 3 minutes, then shutdown and sleeping for 5 minutes etc.

© Pi Modules

COMMAND: @RTCCF

Valid for the UPiS BASIC and UPiS ADVANCED

Meaning: Real **T**ime **C**lock **C**orrection **F**actor

Usage: @rtccf or **@RTCCF**

Disable the RTCCF correction procedure (reset the RTCCF counter to 0)

Usage: @rtccf ? or **@RTCCF ?**

Show the set value of the RTCCF counter

Usage: @rtccf ! or **@RTCCF !**

Show the current value of the running RTCCF counter. This counter is decreasing until reaches value of 0 and makes correction.

Usage: @rtccf <number> - or **@RTCCF <number> -**

Set the current value of the RTCCF counter to decrease of 1 second the RTC after <number> seconds. The <number> must be from 0 up to 4294967295 (int32)

Usage: @rtccf <number> + or **@RTCCF <number> +**

Set the current value of the RTCCF counter to increase of 1 second the RTC after <number> seconds. The <number> must be from 0 up to 4294967295 (int32)

Results/Explanation:

The implemented RTC as all other RTCs has a small difference of crystal frequency. This small difference produces a small drift between **UPiS** RTC and other RTCs (i.e. internet time). Cumulating of this drift within a long time can produce couple of second drift between **UPiS** RTC and other time sources. This drift is always in the same direction, therefore a small correction that will be added or subtracted correct it. The **RTCCF** command adds or subtracts this correction every predefined number of seconds. User need to measure this drift within a day or week, calculate the number of second when elapsed when difference is of 1 second and add it or subtract. One Day is 86400 seconds, one Week is 604800 seconds and one Month is 2419200 seconds. Each command use; is confirmed by **UPiS** reply with detailed description what has been done.

Examples: **"RTCCF 10000 – "means subtract every 10000 seconds, one second from the RTC**

"RTCCF 10000 + "means add every 10000 seconds, one second to the RTC

APPENDIX B Table of LED Indications

Indicators	

LED **CHG** (GREEN)	• LIGHT when charger is working and battery is charged
	• DARK when charger is not working:
	  ○ Battery is fully charged
	  ○ Battery charger is switched OFF (by the integrated microcontroller)
	• FAST BLINKING
	  ○ Battery is not connected
	  ○ Battery is fault

LED **BAT** (GREEN)	• LIGHT when Boost Switching Converter is working (with load or not) • DARK when Boost Switching Converter is working • LIGHT for a short time (9 mS) when system check RaspberryPi® Powering Status in Low Powering Mode
LED **EXT** (GREEN)	• LIGHT when External Extended Powering Cable is connected and system powered from it • DARK when External Extended Powering Cable is not connected
LED **USB** (GREEN)	• LIGHT when UPiS micro USB Powering Cable is connected – it doesn't mean necessarily that system is powering from it • DARK when UPiS micro USB Powering Cable is not connected
Dual Color LED **STA** and **STB**	**STB** (RED LED): • DARK if nothing important is happening • Flashes 10 times every 100 mS when measuring for the first time the mean powering values (Voltages, Current and Temperature). It takes 2 seconds. • LIGHTs for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure • LIGHTs for 100 mS every 1000 mS when UPiS is running on battery backup power and battery level is higher than 3.4V and lower than 3.6V • LIGHTs for 100 mS every 500 mS when UPiS Advanced is running on battery backup power and battery level is lower than 3.4V and higher than 3.2V Note: When Battery level is lower than 3.2 V, the system automatically initiates the File Safe RaspberryPi® Shut Down Procedure in order to save power for the RTC. The cut off power of the ~~LiPO~~LiPo Battery is 3V. **STA** (GREEN LED): • Flashes 10 times every 20 mS when power source has been changed (after 3.6 seconds of cable connection or disconnection)

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	• LIGHTs for 100 mS every 500 mS when cable power is connected • LIGHTs for 100 mS every 2000 mS when UPiS is running on battery backup power and battery level is higher than 3.6V (typical running conditions on battery) • DARK if system is in Low Power Mode

APPENDIX C Technical Specifications

Uninterruptible Power intelligent Supply Advanced Technical Specifications Firmware Version 1.00	
RaspberryPi® Interface	
P1 Connector Plug-in	Type: Top End Stack
RaspberryPi® ON/OFF	Hardware ON/OFF switch cutting 5V supply to the RaspberryPi®
P1 Connector PINs used	Standard: • GND: (P1 Connector PINs used 6, 9, 14, 20, 25) • 5V: (P1 Connector PINs used 1, 4)
	Optional Selectable by jumpers: • SDA0: (P1 Connector PIN used: 3) • SCL0: (P1 Connector PIN used: 5) • TXD0: (P1 Connector PIN used: 8) • RXD0: (P1 Connector PIN used: 10) • GPIO_GEN3 as 1-wire/IO pin: (P1 Connector PIN used: 15) • GPIO_GEN2 as SHTDWN pin: (P1 Connector PIN used: 13) • GPIO_GEN0 as RELAY CTRL: (P1 Connector PIN used: 11)
Integrated Battery	
Type	~~LiPO~~LiPo
Capacity	2600 mAh
Nominal Voltage	3.7 V
Integrated protection	Over Charge/Over Discharge PCB
UPiS on Bard Protection	• Cut-Off Jumper • PTC Resettable Fuse 2.6 A • Analog Thermometer • Microcontroller Supervised Charger with Cut-Off pre-conditions • Continuously current and voltage monitoring
Battery Life	400 Full charge/discharge cycles
Working temperature	-10 up to +60 Celsius degrees
Weight	
Size	
Integrated Automatic Intelligent ~~LiPO~~LiPo Charger	
Charging Modes	• Full Charging Cycle • Trickle Charging
Charging Current	Continuous current 212 mA, Voltage 4.2 V
Charging Protection	• Thermal • Voltage • Current (stop charging if total current of the system exceeds 750 mA)
Cable Powering Inputs	
Extended External Powering	• Input Voltages:

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	○ 7V DC – 18 VDC • Protection: ○ Inverse Polarity ○ PTC Resettable Fuse 1.1 A ○ Transient Voltage Suppression • Conversion Type to 5 VDC: ○ Switching Buck type Converter at 1.6 MHz • Efficiency: ○ More than 85% at 12V in and 850 mA out
UPiS micro USB	• Input Voltages: ○ 5V DC (within USB Powering Specifications) • Protection: ○ Mechanical Inverse Polarity ○ PTC Resettable Fuse 1.25 A ○ Transient Voltage Suppression
P1 Connector (optional) Then system is powered through the RaspberryPi® micro USB	• Input Voltages: ○ 5V DC (within RaspberryPi® powering specifications) • Protection: ○ None (however supply is fully protected by the RaspberryPi® supply system NOTE: Will be available with the new version of Firmware V1.02 update. However, a big part of the UPiS functionality does not work with this source of powering. It is recommended ONLY when it is not possible (due to mechanical cabling) to remove the USB cable powering the Pi.
Cable Powering Source Recognition	Automatic, with priority to External Extended Powering
Cable Powering Outputs	
User Protected 5V	• Protection: ○ PTC Resettable Fuse 140 mA • Maximum current: ○ 140 mA
User non-protected 3.3V (Suggested usage is to supply 1-wire interface)	• Protection: ○ IC by itself • Maximum current: ○ 100 mA NOTE: This is independent and separate from the RaspberryPi® powering system and used in the UPiS to supply RS232 Level Converter Interface. It can also be used for the suggested 1-wire Interface only.
UPS (Power Battery Backup) Functionalities	
UPS Type	Off-line with extremely fast switching time and intermediate power preservation
Power Loss Monitoring	On P1 connector 5V PINs every 120 uS
Power Loss Battery Backup Activation Condition	• Failing detection within 360 us (3 samples) • Voltage level less that 4.3V (programmable) at any sample
Power Battery Backup	Less than 14 uS within a 120 uS window (usual 3uS)

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Activation Time	
Power Return Conditions	3.6 s after power return and stabilization on cable powering inputs

Battery Backup Electrical Specifications	• 5V DC on P1 connector 5 V PINs
	• Total Supplied Current by the Battery System at 5 V:
	  ○ Guaranteed 850 mA
	  ○ Tested 1000 mA

Switching Converter Efficiency	More than 85% at 3.7 V input and 850 mA out
Low Powering Mode Current Consumption (all devices are switched off and system is disconnected from the Raspberry Pi®)	• 70 uA with RTC running • When checking if RaspberryPi® has been switched ON, 300 uA for a period of 9 mS. Repetitive checking, which is programmable by the user, defaults to 5 s
RaspberryPi® Estimated Running Time with typical load of 350 mA	About 5 hours with full battery charge
Interfaces	
RS232 (12V) Level Converter	Connectivity to: • RaspberryPi® Serial Port • UPiS micro USB Port
UPiS micro USB	Connectivity to: • RaspberryPi® Serial Port • UPiS Serial Port • UPiS Serial Port Data Rate 38400 bps 8N2
UPiS Serial Port	Connectivity to: • RaspberryPi® Serial Port • UPiS micro USB • UPiS Serial Port Data Rate 38400 bps 8N2
ESD Protected 1-wire (pull-up to 3.3 V)	Selectable by jumper: • UPiS (read by the RaspberryPi® on its Serial Port) • Directly connection to RaspberryPi® GPIO_GEN3
ESD Protected i-button (pull-up to 3.3 V) (available from firmware version 1.02)	Selectable by jumper: • UPiS (read by the RaspberryPi® on its Serial Port) • Directly connection to RaspberryPi® GPIO_GEN3
ESD Protected I/O Pin (pull-up to 3.3 V)	Selectable by jumper: • UPiS (read by the RaspberryPi® on its Serial Port) • Directly connection to RaspberryPi® GPIO_GEN3
NO RELAY (only for low voltages application)	Selectable by jumper: • UPiS (read by the RaspberryPi® on its Serial Port) • Directly connection to RaspberryPi® GPIO_GEN3 Electrical Guaranteed Load: • 1A 24VDC
Buttons	
UPiS **RST**	Used for: • UPiS System Reset (restarts UPiS, RTC and RaspberryPi®) • Activation of Bootloader functionality
UPiS **SDWN**	Used for:

	• Activation of Bootloader functionality • Restarts RaspberryPi® without resetting UPiS RTC • File Safe RspberryPi® Shutdown Procedure
Indicators	

LED **CHG** (GREEN)	• LIGHT when charger is working and battery is charged
	• DARK when charger is not working:
	  ○ Battery is fully charged
	  ○ Battery charger is switched OFF (by the integrated microcontroller)
	• FAST BLINKING
	  ○ Battery is not connected
	  ○ Battery is fault

LED **BAT** (GREEN)	• LIGHT when Boost Switching Converter is working (with load or not) • DARK when Boost Switching Converter is working • LIGHT for a short time (9 mS) when system check RaspberryPi® Powering Status in Low Powering Mode
LED **EXT** (GREEN)	• LIGHT when External Extended Powering Cable is connected and system powered from it • DARK when External Extended Powering Cable is not connected
LED **USB** (GREEN)	• LIGHT when UPiS micro USB Powering Cable is connected – it doesn't mean necessarily that system is powering from it • DARK when UPiS micro USB Powering Cable is not connected
Dual Color LED **STA** and **STB**	**STB** (RED LED): • DARK if nothing important is happening • Flashes 10 times every 100 mS when measuring for the first time the mean powering values (Voltages, Current and Temperature). It takes 2 seconds. • LIGHTs for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure • LIGHTs for 100 mS every 1000 mS when UPiS is running on battery backup power and battery level is higher than 3.4V and lower than 3.6V • LIGHTs for 100 mS every 500 mS when UPiS Advanced is running on battery backup power and battery level is lower than 3.4V and higher than 3.2V Note: When Battery level is lower than 3.2 V, the system automatically initiates the File Safe RaspberryPi® Shut Down Procedure in order to save power for the RTC. The cut off power of the ~~LiPO~~LiPo Battery is 3V. **STA** (GREEN LED): • Flashes 10 times every 20 mS when power source has been changed (after 3.6 seconds of cable connection or disconnection)

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	• LIGHTs for 100 mS every 500 mS when cable power is connected • LIGHTs for 100 mS every 2000 mS when UPiS is running on battery backup power and battery level is higher than 3.6V (typical running conditions on battery) • DARK if system is in Low Power Mode
Sensors	
Analog Temperature Sensor	Accuracy - 1 Degree Celsius Accessible (readable) only via Serial UPiS interface via commands @STATUS or @ANTMPC or @ANTMPF When temperature is higher than 65 degrees Celsius or lower than -10 degrees Celsius then system automatically initiates the File Safe RaspberryPi® Shut Down Procedure.
System Current Sensor	Real Time System Current measure Accuracy - 10mA The measurement contains: • The RaspberryPi® current consumption • Battery Charging current consumption • Relay ON current consumption • Microcontroller current consumption • RS232 Level Converter current consumption • Serial Bridge current consumption • UPiS LEDs current consumption • Various Components of the UPiS current consumption Note: Some measurements will be available with the Firmware update 1.02 as they are undergoing testing.
Battery Voltage Sensor	Real Time System Current measure Accuracy - 10 mV
External Extended Powering Voltage Sensor	Real Time System Current measure Accuracy - 10 mV
micro USB Powering Voltage Sensor	Real Time System Current measure Accuracy - 10 mV
RaspberryPi® P1 5V Powering Voltage Sensor	Real Time System Current measure Accuracy - 10 mV
Additional Features	
Emulated RTC (DS1307) with drift correction system	Emulated RTC based on the crystal of 32768 KHz. Communicates with RaspberryPi® via I2C and emulates the DS1307. It will be provided on the Firmware update 1.01.
Timed Start Up/Shutdown	Programmed on RTC. Timer starts up and shutdown based on 1 minute intervals. • Maximum programmed time is 1000 minutes • Minimum programmed time is 2 minutes
XTEA Encryption System	XTEA Cryptographic system with user keys. Programmable providing Cryptographic protection of professional software written for the RaspberryPi®. It will be provided on the Firmware update 1.02.

Scripting Commands	23 commands are currently implemented. These will be improved and added to according to requests from users and system developments. Each command starts always with '@':	
	@FACTORY	Factory Defaults
	@VERSION	Hardware and Firmware Version
	@STATUS	System Status
	@RON	Relay ON
	@ROFF	Relay ON
	@ANTMPC	Analog Temperature Celsius
	@ANTMPF	Analog Temperature Fahrenheit
	@PM	Powering Mode
	@CHGR ON/OFF	Charger ON or OFF
	@RPI	RaspberryPi® P1 5V Voltage level
	@EPR	External Extended Voltage level
	@USB	UPiS USB Voltage level
	@BAT	UPiS Battery Voltage level
	@CUR	System Current Consumption
	@1WIREC	1-wire Temperature Celsius
	@1WIREF	1-wire Temperature Fahrenheit
	@PWRINFO ON/OFF	Powering change source trigger
	@LPRSTA	Low Powering Restart Time
	@TIME	Time
	@DATE	Date
	@START	Timed RaspberryPi® Startup
	@STOP	Timed RTC Correction Factor
	@RTCCF	RaspberryPi® Shutdown

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Uninterruptible Power intelligent Supply Basic Technical Specifications Firmware Version 1.00	
RaspberryPi® Interface	
P1 Connector Plug-in	Type: Top End Stack
RaspberryPi® ON/OFF	Hardware ON/OFF switch cutting 5V supply to the RaspberryPi®
P1 Connector PINs used	Standard: • GND: (P1 Connector PINs used 6, 9, 14, 20, 25) • 5V: (P1 Connector PINs used 1, 4)
	Optional Selectable by jumpers: • SDA0: (P1 Connector PIN used: 3) • SCL0: (P1 Connector PIN used: 5) • TXD0: (P1 Connector PIN used: 8) • RXD0: (P1 Connector PIN used: 10) • GPIO_GEN2 as SHTDWN pin: (P1 Connector PIN used: 13)
Integrated Battery	
Type	~~LiPO~~LiPo
Capacity	1150 mAh
Nominal Voltage	3.7 V
Integrated protection	Over Charge/Over Discharge PCB
UPiS on Bard Protection	• Cut-Off Jumper • PTC Resettable Fuse 2.6 A • Analog Thermometer • Microcontroller Supervised Charger with Cut-Off pre-conditions • Continuously current and voltage monitoring
Battery Life	400 Full charge/discharge cycles
Working temperature	-10 up to +60 Celsius degrees
Weight	
Size	
Integrated Automatic Intelligent ~~LiPO~~LiPo Charger	
Charging Modes	• Full Charging Cycle • Trickle Charging
Charging Current	Continuous current 212 mA, Voltage 4.2 V
Charging Protection	• Thermal • Voltage • Current (stop charging if total current of the system exceed 750 mA)
Cable Powering Inputs	
UPiS micro USB	• Input Voltages: ○ 5V DC (within USB Powering Specifications) • Protection: ○ Mechanical Inverse Polarity ○ PTC Resettable Fuse 1.25 A ○ Transient Voltage Suppression
P1 Connector (optional) Then system is powered	• Input Voltages:

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trough the RaspberryPi® micro USB	○ 5V DC (within RaspberryPi® Powering Specifications) • Protection: ○ NONE (however supply is fully protected by the RaspberryPi® supply system NOTE: Will be available with the new version of Firmware V1.02 update. However, a big part of the UPiS functionality does not work with this source of powering. It is recommended ONLY when it is not possible (due to mechanical cabling) to remove the USB cable powering the Pi.
Cable Powering Source Recognition	Automatic
UPS (Power Battery Backup) Functionalities	
UPS Type	Off-line with extremely fast switching time and intermediate power preservation
Power Loss Monitoring	On P1 connector 5 V PINs every 120 uS
Power Loss Battery Backup Activation Condition	• Falling edge detection within 360 us (3 samples) • Voltage level less that 4.3 V (programmable) at any sample
Power Battery Backup Activation Time	Less than 14 uS within a 120 uS window (usual 3uS)
Power Return Conditions	3.6 s after Power Return and Stabilization on Cable Powering Inputs
Battery Backup Electrical Specifications	• 5V DC on P1 connector 5 V PINs • Total Supplied Current by the Battery System at 5 V: ○ Guaranteed 850 mA ○ Tested 1000 mA
Switching Converter Efficiency	More than 85% at 3.7 V input and 850 mA out
Low Powering Mode Current Consumption (all devices are switched off and system is disconnected from the Raspberry Pi®)	• 70 uA with RTC running • When checking if RaspberryPi® has been switched ON, 300 uA for a period of 9 mS, repetitions of checking is programmed by user, default is 5 s
RaspberryPi® Estimated Running Time with typical load of 350 mA	About 2 hours with full battery charge
Interfaces	
UPiS micro USB	Connectivity to: • RaspberryPi® Serial Port • UPiS Serial Port • UPiS Serial Port Data Rate 38400 bps 8N1
UPiS Serial Port	Connectivity to: • RaspberryPi® Serial Port • UPiS micro USB • UPiS Serial Port Data Rate 38400 bps 8N1
Buttons	
UPiS **RST**	Used for: • UPiS System Reset (restarts UPiS, RTC and

	RaspberryPi®) • Activation of Bootloader functionality
UPiS **SDWN**	Used for: • Activation of Bootloader functionality • Restarts RaspberryPi® without resetting UPiS RTC • File Safe RspberryPi® Shutdown Procedure
Indicators	

LED **CHG** (GREEN)	• LIGHT when charger is working and battery is charged
	• DARK when charger is not working:
	  ○ Battery is full charged
	  ○ Battery charger is switched OFF (by the integrated microcontroller)
	• FAST BLINIKNG
	  ○ Battery is not connected
	  ○ Battery is fault

LED **BAT** (GREEN)	• LIGHT when Boost Switching Converter is working (with load or not) • DARK when Boost Switching Converter is working • LIGHT for a short time (9 mS) when system check RaspberryPi® Powering Status in Low Powering Mode
LED **USB** (GREEN)	• LIGHT when UPiS micro USB Powering Cable is connected – it doesn't mean necessary that system is powering from it • DARK when UPiS micro USB Powering Cable is not connected
Dual Color LED **STA** and **STB**	**STB** (RED LED): • DARK if nothing important happens • Flashes for 10 times every 100 mS when measures first time the mean powering values (Voltages, Current and Temperature). It takes 2 second. • LIGHTs for 800 mS every 1 s within 40 s time frame when system is in File Safe Shutdown Procedure • LIGHTs for 100 mS every 1000 mS when UPiS is running on battery backup powering and battery level is higher than 3.4V and lower than 3.6V • LIGHTs for 100 mS every 500 mS when UPiS Advanced is running on battery backup powering and battery level is lower than 3.4V and higher than 3.2V Note: When Battery level is lower than 3.2 V, then system automatically initiates the File Safe RaspberryPi® Shut Down Procedure in order to save power for the RTC. The cut off power of the ~~LiPO~~LiPo Battery is 3 V. **STA** (GREEN LED): • Flashes for 10 times every 20 mS when powering source has been changed (after 3.6 seconds of cable connection or disconnection) • LIGHTs for 100 mS every 500 mS when cable power is

	connected • LIGHTs for 100 mS every 2000 mS when UPiS is running on battery backup powering and battery level is higher than 3.6V (typical running conditions on battery) • DARK if system is in Low Powering Mode
Sensors	
Analog Temperature Sensor	Accuracy 1 Celsius Degree Accessible (readable) only via Serial UPiS interface via commands @STATUS or @ANTMPC or @ANTMPF When Temperature is Higher than 65 Celsius Degree or lower than -10 Celsius Degree then system automatically initiates the File Safe RaspberryPi® Shut Down Procedure.
System Current Sensor	Real Time System Current measure Accuracy 10mA The measurements contains: • The RaspberryPi® current consumption • Battery Charging current consumption • Microcontroller current consumption • Serial Bridge current consumption • UPiS LEDs current consumption • Various Components of the UPiS current consumption Note: There are already available separated measurements of the RaspberryPi® current consumption and the rest of the system. It will be provided on the Firmware update 1.02 due to testing process.
Battery Voltage Sensor	Real Time System Current measure Accuracy 10 mV
micro USB Powering Voltage Sensor	Real Time System Current measure Accuracy 10 mV
RaspberryPi® P1 5V Powering Voltage Sensor	Real Time System Current measure Accuracy 10 mV
Additional Features	
Emulated RTC (DS1307) with drift correction system	Emulated RTC based on the crystal of 32768 KHz. Communicated with RaspberryPi® via I2C and Emulate the DS1307. It will be provided on the Firmware update 1.01 due to testing process.
Timed Start Up/Shutdown	Programmed on RTC timer starts up and shutdown based on 1 minute intervals. • Maximum programmed time is 1000 minutes • Minimum programmed time is 2 minutes
XTEA Encryption System	XTEA Cryptographic system with User Keys Programming providing Cryptographic protection of professional software written for the RaspberryPi®. It will be provided on the Firmware update 1.02 due to testing process.
Scripting Commands	A list of 18 commands is already implemented and will be upgraded with more according to user's requests and future system developments. Each command starts always with '@' There are: @FACTORY — Factory Defaults

	@VERSION	Hardware and Firmware Version
	@STATUS	System Status
	@ANTMPC	Analog Temperature Celsius
	@ANTMPF	Analog Temperature Fahrenheit
	@PM	Powering Mode
	@CHGR ON/OFF	Charger ON or OFF
	@RPI	RaspberryPi® P1 5V Voltage level
	@USB	UPiS USB Voltage level
	@BAT	UPiS Battery Voltage level
	@CUR	System Current Consumption
	@PWRINFO ON/OFF	Powering change source trigger
	@LPRSTA	Low Powering Restart Time
	@TIME	Time
	@DATE	Date
	@START	Timed RaspberryPi® Startup
	@STOP	Timed RaspberryPi® Shutdown
	@RTCCF	RTC Correction Factor

WARRANTY

UPiS is warranted to be free from defects in materials and workmanship from the date of purchase for a 12 month period. Warranty excludes, normal wear and tear, accidental or deliberate damage.

We will accept returns ONLY on the following conditions. These conditions do not affect your statutory rights.

In the case of faulty items we will repair the items as per the manufacturer's original warranty.

Products which are returned for warranty repair will be forward shipped at the customer's expense. After assessment, and if the products are covered under warranty, we will pay return freight costs. However, if a fault cannot be found, and the product is deemed to be in good working order or not covered by warranty, the customer pays shipping both ways and pays Pi Modules, a service fee prior to the return of the products according to Pi Modules service price list.

If the goods are covered under warranty, we will cover only the return costs, and the repair or replacement of the product as we see fit.

We will only accept for repair only the items, which are returned in the original packaging (including all parts contained in the packaging) and are undamaged (including original packaging).

Warranty excludes, normal wear and tear, accidental or deliberate damage, any such items will not be replaced.

In the case of refund, no such refund will ever exceed the original purchase cost of the item and will not include any associated postage costs.

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